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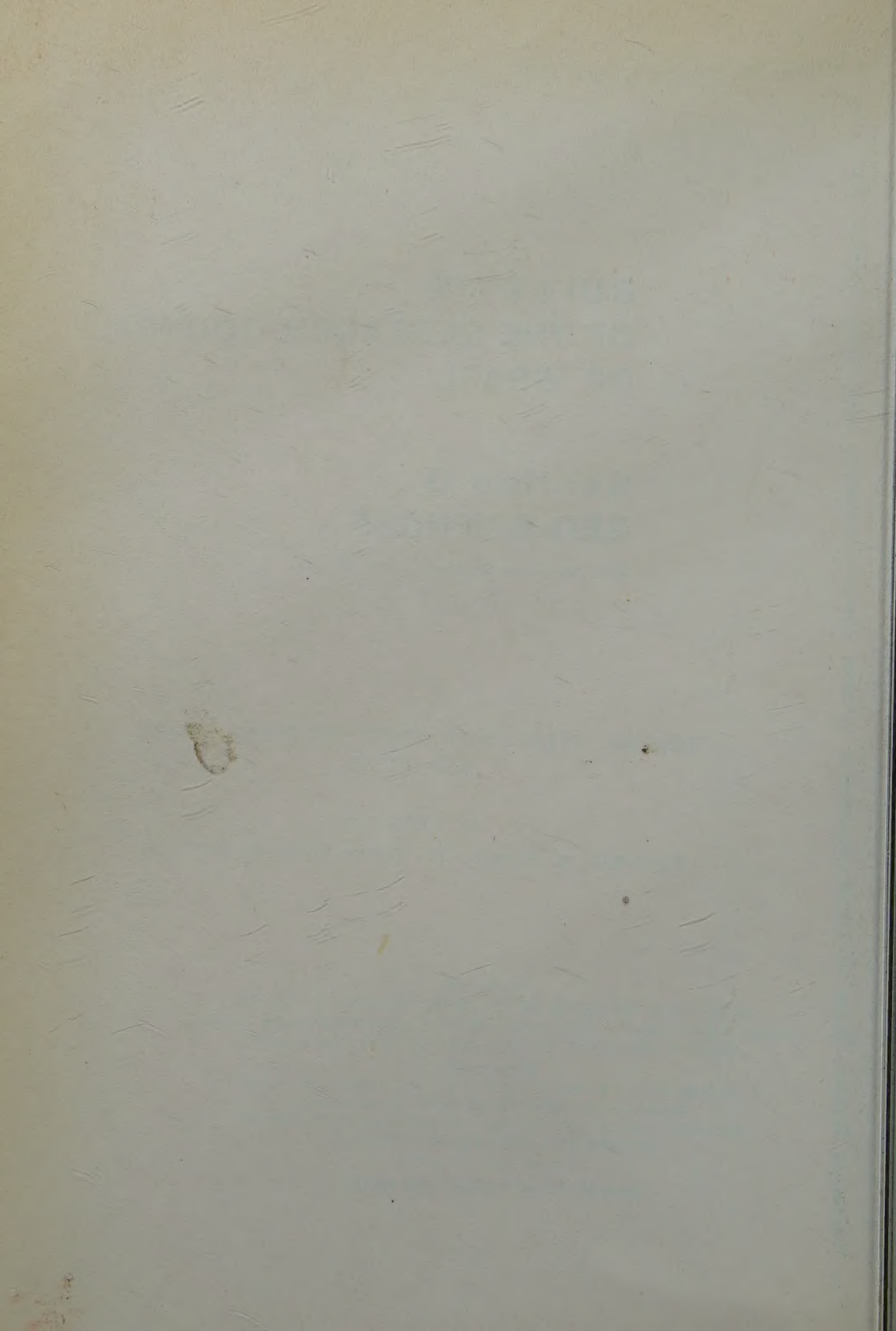
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Bull. Res. Council of Israel. G. Geo-Sciences

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A. LERMAN

Department of Geology, The Hebrew University, Jerusalem



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TRIASSIC PELECYPODS FROM SOUTHERN ISRAEL AND SINAI

A. LERMAN

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ABSTRACT

Triassic pelecypod fauna from Ramon and Araif-el-Naga are discussed in stratigraphic sequence. On the bases of identified fauna three biostratigraphic units, viz. *Beneckeia*-zone (Anisian), *Neoschizodus laevigatus*-*Myophoria coxi*-zone (Lower Ladinian) and *Pseudop-lacunopsis fissistriata*-zone (Middle to Upper Ladinian), are proposed for Ramon. These zones are correlated with their equivalents in Araif-el-Naga. The examined Middle Triassic fauna is of a mixed character and is related to the faunae of Germany, Alps, Spain and North Africa. On the other hand, the Upper Triassic fauna is of more restricted, Alpine affinities. Inferred mode of life of a gregarious, bank-forming species, and of some adhering pelecypods is discussed. Faunal impoverishment of the Upper Triassic strata of Ramon is supposed to be in accordance with the development of saline environment. Among 41 identified pelecypod species two new species, *Myophoria multicostata* sp. nov. and *Trigonodus tenuidentatus* sp. nov., are described.

INTRODUCTION

The rocks exposed in the core of the Ramon anticline in the Negev, Southern Israel (locally known as Makhtesh Ramon — the erosion cirque of Wadi Raman) were mapped for the first time by the geologists of the P.D.P. (Petroleum Development Palestine Limited, a subsidiary of the Iraq Petroleum Company) before and during the World War II. The fauna determined by Avnimelech, Picard, and Vroman at the Hebrew University, and the section given by the P.D.P. geologists were later published by Shaw (1947, p. 17). This area was subsequently mapped in more detail by Bentor and Vroman (1951), and the geomorphology of the region was described by Picard (1951). A more elaborate discussion on the stratigraphy of the lower and the middle parts of the Triassic section and some faunal descriptions were published by Brotzen (1957). Most recently the Triassic outcrops in Ramon were mapped on a 1:20,000 scale by Zak (1957). Some of the ammonites found in the sequence have been studied by Parnes (1958).

The present work has been carried out in partial fulfilment of the requirements for obtaining a M. Sc. degree at the Hebrew University, and it has been directed and supervised by Professor Avnimelech, of the Department of Geology. The material from Ramon described in the present paper was collected by the author during three weeks of field work in 1958, and additional material was made available from the collections of the Geological Survey of Israel. Fauna from Araif-el-Naga in Sinai was collected by Zak, of the Geological Survey of Israel.

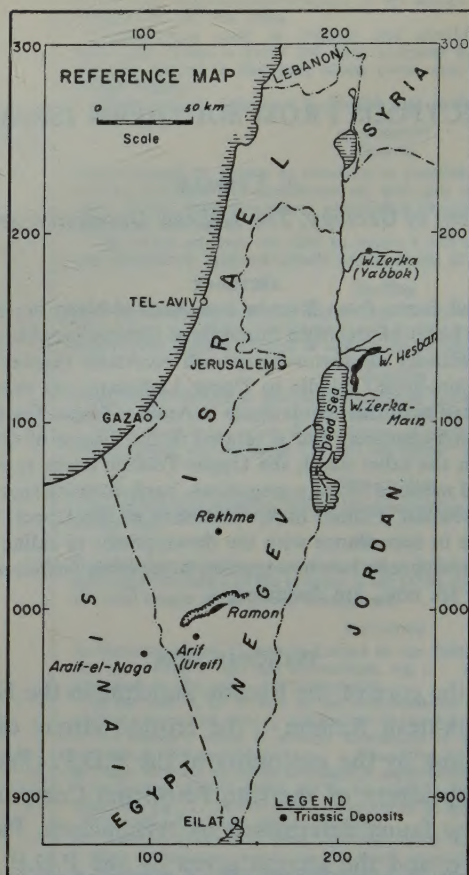


Figure 1
Reference map of the Triassic localities in Israel, Egypt and Jordan

THE TRIASSIC SEQUENCE OF RAMON

The Triassic sedimentary rocks in Ramon are exposed over an area of approximately 30 sq. km., and attain a thickness of 486 meters. They have been subdivided into seven rock-units by Zak (1957):

unit T ₇ — Lagoonar limestone	— 23 m
unit T ₆ — Gypsum beds	— 156 m
unit T ₅ — Limestone and Dolomite	— 54 m
unit T ₄ — Limestone and Gypsum	— 52 m
unit T ₃ — Limestone and Marl	— 35 m
unit T ₂ — Organogenic limestone	— 40 m
unit T ₁ — Sandstones and Shales	— 126 m
Total	486 m

(These thicknesses have been approximated to the nearest meter).

A brief description of these main units as observed by the author is as follows:

At the base of the unit T₁ (Figure 3) quartzites and quartzitic sandstones, about 20 m thick, overlie variegated "Nubian" sandstones. The rest of the unit T₁ is composed mainly of greenish-gray to red clayey-silty and sandy sediments with occasional thin intercalations of limestone containing poorly preserved internal moulds of pelecypods. Plant remains and fossil wood are also found in this part of the section. Several specimens of *Lingula* were recorded from here by Brotzen (1957, p. 196). It is only toward the upper half of this unit where a better preserved fauna is found.

The unit T₂ and the lower part of the unit T₃ are mainly built of yellow limonitic and grayish limestones with clayey and marly intercalations. These units are very fossiliferous.

The upper part of T₃ and the unit T₄, which contain very little fauna, are exposed as cuestas built of dolomitic, concretionary, and argillaceous limestones with some green-gray shales and thin gypsum beds intercalated in the section.

The unit T₅, although mainly dolomitic, contains two horizons of fossiliferous limestones, and it is overlain by the unit T₆ which consists of gypsum layers with black clayey-shaley and a few dolomitic intercalations. Two thin (20 cm each) limestone beds containing poorly preserved fauna are, however, present.

The unit T₇ is built of thin laminated limestones and dolomites. As yet no determinable fauna has been found in these beds.

The whole Triassic sequence is unconformably overlain by red, silty, lateritic sediments of presumably Jurassic age. This laterite contains at its base black silty-pyritic lenses with fossil flora of *Cupressinocladus* described by Chaloner and Lorch (1960).

THE PELECYPOD FAUNA OF RAMON

From the fossiliferous beds of the upper part of the unit T₁ the following species have been identified: *Beneckeia* sp.; *Lingula tenuissima* Bronn; *Myalina beneckeii* Brotzen; *Myophoria vulgaris* (Schlotheim); *M. intermedia* Schaubert; *Neoschizodus orbicularis* (Bronn); *Gervillia joleaudi* Schmidt; *Enantiostreon difforme* (Schlotheim); *Trigonodus tenuidentatus* sp. nov.

The presence of *Beneckeia* sp. and of *N. orbicularis* indicates these strata to be of Anisian (= early Muschelkalk) age. The thickness of the beds containing the above listed species is 14 m, as measured by the author, and they certainly belong to the upper part of the "*Beneckeia*-beds" described by Brotzen (1957) and measured by him as being 28 m thick.

All the species mentioned above are restricted in their vertical distribution to the 14 m thick strata, with two exceptions, viz. *G. joleaudi* and *E. difforme* which also occur in unit T₂. "*Beneckeia*-beds" are overlain by approximately 19 meters of unfossiliferous clayey-silty shales and slightly crossbedded sandstones. Above these strata occurs a 4-5 m thick layer of dark limestone almost entirely built

of the shells of *Myalina ramanensis* Brotzen (Figure 2a). This layer is overlain by 11 m of crossbedded sandstones and clayey shales which constitute the top of the unit T₁.

The unit T₂ consists of 36–38 m of frequently alternating limonitic limestones and yellow-grayish clayey and marly shales. The top of the unit is marked by 3 m of hard, rubbly, dense, stylolitic limestone which is unfossiliferous. Below this stratum a rich fauna is found in the unit T₂:

Leda cf. *fibula* Mansuy; *Palaeoneilo elliptica* (Goldfuss); *Myophoria elegans* (Dunker); *M. germanica* Hohenstein; *M. coxi* Awad; *M. multicostata* sp. nov.; Cf. *Myophoriopsis subundata* (Schauroth); *Neoschizodus laevigatus* (Ziethen); *Pseudoplacunopsis fissistriata* (Winkler); *Placunopsis* cf. *flabellum* Schmidt; *Pl.* cf. *ostracina* (Schlotheim); *Enantiostreon difforme* (Schlotheim); *Ostrea montis-caprillis* Klipstein; *Modiola* cf. *raibliana* Bittner; *Modiola* cf. *salzstettensis* Hohenstein; *Cassianella* cf. *decussata* (Münster); *Gervillia joleaudi* Schmidt; *G.* aff. *albertii* (Goldfuss); *G.* cf. *bouéi* (Hauer); *Lima striata* (Schlotheim); *Mysidiopora* cf. *vix-costata* (Stoppani); *Pecten discites* (Schlotheim); *P.* cf. *laevigatus* (Schlotheim); *P. albertii* (Goldfuss); *Schafhäutlia* aff. *mellingi* (Hauer); *Anodontophora münsteri* (Wissmann); *Pleuromya* cf. *mactroides* (Schlotheim).

In the same strata with these pelecypods such ammonites as *Protrachyceras hispanicum* Mojsisovics and *Monophyllites sphaerophyllus* Hauer were recorded (determined by A. Parnes; deposited in the Palaeont. Coll., Dept. Geol., Hebrew Univ., registered nos. 20481 and 20482, respectively). The presence of these species points to an early Ladinian (= middle Muschelkalk) age.

The sequence of shales, limestone with *Myalina ramanensis*, and crossbedded sandstones intercalated between the "Beneckeia-beds" and the unit T₂ is supposed to be of the latest Anisian age. However, these beds may belong to a transition phase from Anisian to Ladinian or, in other words, from the Lower to the Middle Muschelkalk.

Above unit T₂ occur 6 m of poorly fossiliferous black nodular limestones belonging to the unit T₃, and which in turn are overlain by 7 m of white-grayish argillaceous limestone (Figure 2c) containing *Pseudoplacunopsis fissistriata* (Winkler), *Lima* cf. *telleri* Bittner, *Pecten discites* (Schlotheim), *Ostrea montis-caprillis* Klipstein, Cf. *Myophoriopsis subundata* (Schauroth).

In the rest of unit T₃ and over most of unit T₄ only few gastropods and some poorly preserved internal moulds of pelecypods are found. It is only in the uppermost 4 m of the unit T₄ (Figure 3) that a distinct fauna appears, composed of *Myophoria woehrmanni* Bittner, *Ostrea montis-caprillis* Klipstein, *Pseudoplacunopsis fissistriata* (Winkler). These pelecypods are found together with new species (Parnes 1958) of the ammonite genera *Protrachyceras* and *Clonites*. According to Parnes (op. cit.) the latter new species bear close affinities to *P. sirenitoides* Kittl and to *C. acutocostatus* (Klipstein) respectively, indicating thus an early Carnian age for these beds.

Although no ammonites were found in the fossiliferous part of unit T₃ (the argillaceous limestone with *Pseudoplacunopsis fissistriata*, etc.) the position of this unit

between the Lower Ladinian (unit T₂) and the Lower Carnian (the uppermost part of unit T₄ — *Clionites*-bed) indicates it to be Middle to Upper Ladinian.

Of the previously mentioned fossiliferous horizons of unit T₅, the lower one contains only crushed oyster like shells, while the upper one contains an abundant fauna consisting of *Avicula aspera* Pichler, *Myophoria woehrmanni* Bittner, *Mysidiop-tera* cf. *gremblchii* Bittner, *Pecten discites* (Schlotheim), *P. aff. subalternans* d'Orbigny *Schafhäutlia* aff. *mellingi* (Hauer), *Cassianella decussata* (Münster), and a gastropod *Zygopleura spinosa* Koken. This fauna points to an early to middle Carnian age, since the species listed are mainly distributed in the St. Cassian and Raibl stages of the Mediterranean Triassic.

Higher appearance of the Triassic fauna in Ramon occurs in two thin limestone horizons intercalated between the gypsum beds of unit T₆. In the lower one *Spiriferina lipoldi* Bittner and ?*Myophoria* sp. are recognizable, and in the upper one *S. lipoldi* Bittner, *Myophoria* sp. ind., numerous minute "aviculas", "mytili", and gastropods occur. No distinct age determination can be made for the unit T₆ on the bases of contained fauna. It certainly cannot be earlier than of middle Carnian age, as the mentioned fossiliferous horizons occur 150 m higher than the stratum with *Avicula aspera*, etc. There is a possibility, however, that the unit T₆ or a part of it is of Norian age.

THE TRIASSIC SEQUENCE OF ARAIF-EL-NAGA

The sedimentary rocks exposed in the core of the Araif-el-Naga dome in Eastern Sinai were recognized by G. H. Awad in the late thirties as being of Middle Triassic age (Awad 1946). During World War II the area was mapped by the geologists of the Standard Oil Company of Egypt, and the fauna collected was determined at the Department of Geology, Hebrew University (Vroman 1946). The columnar section of the Triassic deposits and the list of fauna identified in Jerusalem have been published by Eicher (1947). The Triassic sequence of Araif-el-Naga, as given by Zak (1957a), is similar in lithological composition to one published by Eicher (*op. cit.*) and is as follows (Figure 3):

unit T ₄ + T ₅ — Limestone and Dolomite		
	with Gypsum intercalations —	51 m
unit	T ₃ — Limestone and Marl	— 31 m
unit	T ₂ — Organogenic limestone	— 35 m
unit	T ₁ — Sandstones and Shales	— 68 m
Total		185 m

(These thicknesses have been approximated to the nearest meter).

The unit T₁ is poor in fossils and is composed of quartzitic sandstones overlain by clayey, silty and sandy sediments containing plant remains and fossil wood with some thin limestone intercalations. Unit T₂ and the lower part of T₃ are the main

fossiliferous units. No determinable fauna was found in the upper, limey-dolomitic T₄+T₅ unit. The section is overlain discordantly by red silty-clayey strata of supposed Jurassic age.

THE PELECYPOD FAUNA OF ARAIF-EL-NAGA

Except for two internal moulds of Cf. *Anodontophora fassaensis* (Wissmann) only badly preserved pelecypod fragments have been examined by the author from the lower part of unit T₁. In the upper part of this unit fragments of *Beneckeia* sp. were found in the green, gray clayey-shaly beds containing several thin intercalations of dark limestone. These *Beneckeia*-containing beds are approximately 10 m thick. They are underlain by yellowish crossbedded sandstones. Sandstones with shaly intercalations, which constitute the top of unit T₁, overlie the *Beneckeia*-containing strata

The unit T₂ contains the following species (its uppermost 2–3 meters of black, rubbly, dense limestone remain unfossiliferous);

Myophoria elegans (Dunker); *Myophoria germanica* Hohenstein; *Myophoria coxi* Awad; Cf. *Myophoriopsis subundata* (Schauroth); *Neoschizodus laevigatus* (Zithen); *Pseudoplacunopsis fissistriata* (Winkler); *Placunopsis* cf. *ostracina* (Schlotheim); *Enantiostreon difforme* (Schlotheim); *Gervillia* cf. *bouéi* (Hauer); *Schafhäutlia* aff. *mellingi* (Hauer); *Anodontophora münsteri* (Wissmann).

A lumachelle containing numerous *Pseudoplacunopsis fissistriata* (Winkler) is exposed at the lower part of unit T₃, immediately above some 5–6 m of poorly fossiliferous limestones. Higher in the section no identifiable fauna was found.

STRATIGRAPHIC CORRELATION

For the purpose of time-stratigraphic correlation between the Triassic sections of Ramon and Araif-el-Naga the following biostratigraphic units are proposed:

1. *Beneckeia*-zone.

Locality: Ramon, coord. 13896/99972.

Section: as given by Zak (1957) and reproduced on Figure 2a.

Age: Anisian.

Synonymy: the upper half of the "*Beneckeia*-beds" of Brotzen (1957, p.199). The zone is characterized by the occurrence of *Beneckeia* sp., pelecypod and brachiopod species (p.3) in 14 m of green and gray clayey and silty shales with occasional thin intercalations of argillaceous limestone and very thin gypsum bands. The zone is underlain by clayey, silty, and sandy plant bearing sediments. It is overlain by 19 m of clayey-silty shales and slightly crossbedded sandstones. Details of distribution of the fauna of *Beneckeia*-zone in Ramon and in other localities as well, are shown on Table 6.

A comparative chart of the stratigraphic units introduced by Brotzen (1957), Zak (1957), and by the present author.

Brotzen (1957)		Zak (1957)	Lerman
Bluish l. s.			
<i>Ceratites</i> zones 1—5	Member D <i>Ceratites</i> beds	unit T ₂	<i>Neoschizodus laevigatus</i> - <i>Myophoria coxi</i> -zone
Transgression zone	Member C Reef beds	unit T ₁	
Regression zone			
<i>Beneckeia</i> zones 1—4	Member B <i>Beneckeia</i> beds		<i>Beneckeia</i> - - zone
Wood bearing beds	Member A		

2. *Neoschizodus laevigatus*-*Myophoria coxi*-zone.

Locality: Ramon, coord. 1390/9998-1389/9999.

Section: as given by Zak (1957) and reproduced on Figure 2b.

Age: Lower Ladinian.

Synonymy: the "*Ceratites* zones 1-5" of Brotzen (1957, p. 199).

The zone is defined by the assemblage of pelecypods listed on p. 4, of which *N. laevigatus* and *M. coxi* were arbitrarily chosen as representatives. This assemblage occurs in 36-38 metres of frequently alternating limonitic limestones and yellow-grayish clayey and marly shales. The lower limit of the zone coincides with the lower limit of unit T₂, while its upper limit is drawn 3 m below the top of this unit. The zone is underlain by clayey shales and crossbedded sandstones. It is overlain by approximately 9 m of black, dense, stylolitic, and black,

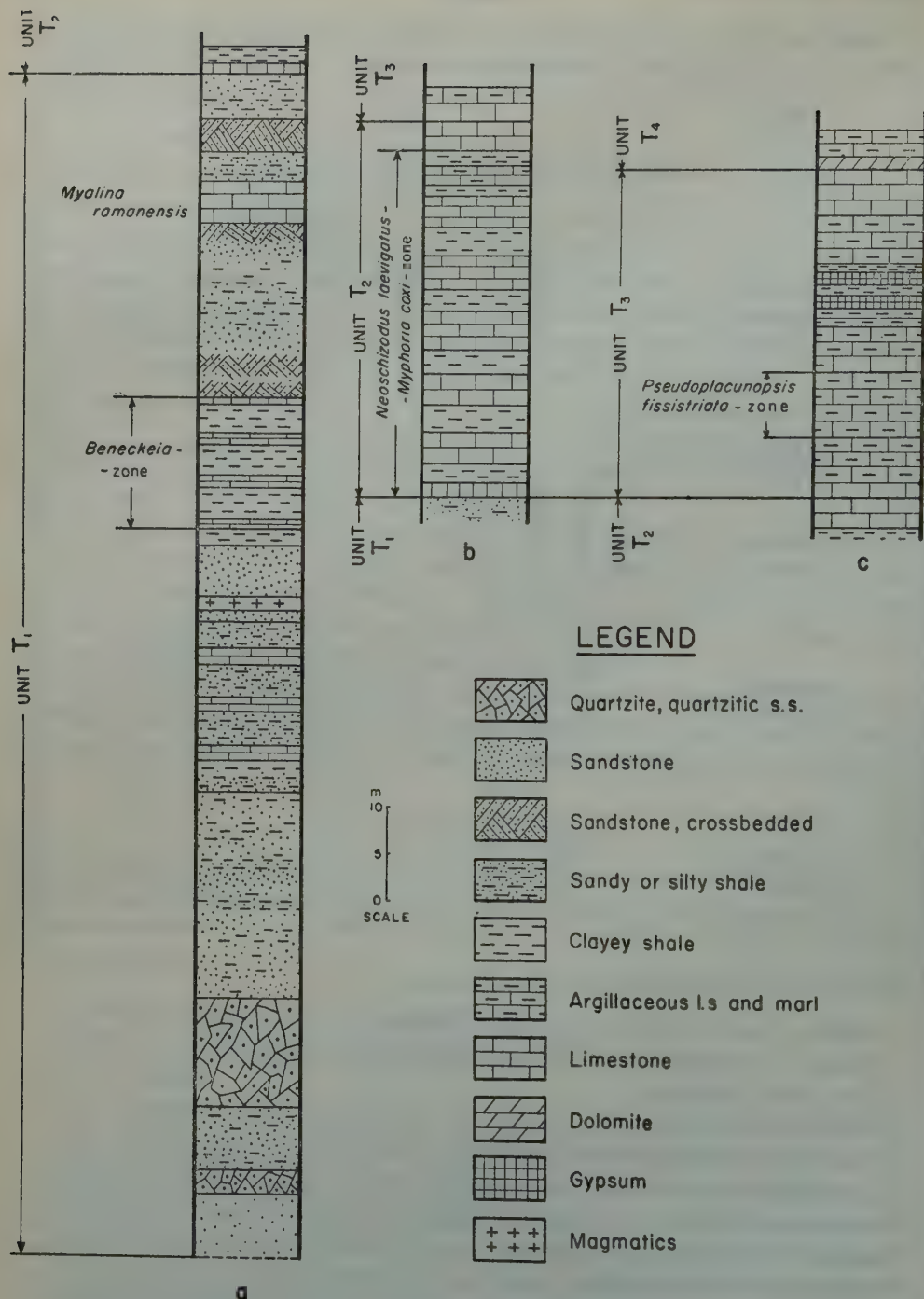
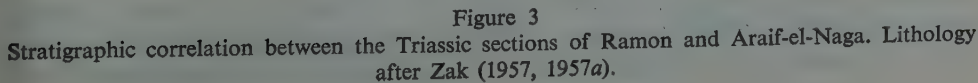


Figure 2
Columnar sections of the assemblage-zones proposed for the Triassic of Ramon. Lithology after Zak (1957).

ARAIF-EL-NAGA



nodular limestones. The general distribution of the fauna of *N. laevigatus-M. coxi*-zone is given on Table 6.

3. *Pseudoplacunopsis fissistriata*-zone.

Locality: Ramon, coord. 13730/99972.

Section: as given by Zak (1957) and reproduced on Figure 2c.

Age: Middle to Upper Ladinian.

The zone is characterized by the predominance of *Pseudoplacunopsis fissistriata* (Winkler) over other species (p. 4) in 6–7 m of bright-gray to white argillaceous limestone which includes several thin bands of coarse grained limestone and gray-green shales. This zone is underlain by 9 m of black, nodular, and black, dense, stylolithic limestones. It is overlain by 1–2 m of reddish-brown limestone containing crinoid remains.

Comparing the columnar sections of the Triassic deposits of Ramon and Araif-el-Naga (Figure 3) the following facts may be deduced: (1) while the middle part of the Araif-el-Naga section, i.e. units T_2 and T_3 , is lithologically similar to the T_2 and T_3 parts of the Ramon section, the sequence subjacent and suprajacent to these units are considerably reduced in Araif-el-Naga; (2) the gypsum deposits present in Ramon (unit T_6) are lacking in Araif-el-Naga where the Jurassic deposits overlie unconformably the $T_4 + T_5$ unit.

Notwithstanding the incomplete faunal record from Araif-el-Naga, the faunal and the lithological similarities, particularly over the T_2 and T_3 units of both localities, are marked. Consequently, it seems probable that the plant-bearing beds of Ramon are correlative with those of Araif-el-Naga. Similarly, the *Beneckeia*-zone, *N. laevigatus-M. coxi*-zone, and *Ps. fissistriata*-zone, proposed for Ramon, can be recognized in Araif-el-Naga as well.

Awad (1946, p. 404) has divided the Triassic section of Araif-el-Naga into the lower or "lumachelle series" and the upper or "clayey series". The main part of the nineteen pelecypod species mentioned by him are distributed in the "lumachelle series". As these same species were found in the *N. laevigatus-M. coxi*-zone in Ramon and in its equivalent in Araif-el-Naga, it seems that Awad's "lumachelle series" is, in its upper part at least, identical with the above mentioned zone. Both the lithology and the fauna, particularly the previously listed pelecypod species (p.4), and abundance of numerous *Coenothyris vulgaris* (Schlotheim), nautilids, ceratites, and naticid gastropods at both localities, make the *N. laevigatus-M. coxi*-zone easily recognizable in the field.

REMARKS ON FAUNAL AFFINITIES

As shown on the Stratigraphic Distribution Chart (Table 6), the Middle Triassic (Anisian-Ladinian) fauna of Ramon and Araif-el-Naga is composed of elements widely distributed in the Alpine region, Germany, Upper Silesia, Spain, and North

Africa. Of the species recognized in Ramon eleven appear to be common also with the Triassic of Transjordan. However, it is difficult to compare in detail the stratigraphic distribution of these species in the Negev with their distribution in Transjordan, due to some tectonical complications which prevented Blake (1935, p. 73) from giving an accurately measured columnar section of the Triassic deposits in the Wadi Hesban.

The appearance of such forms as *Modiola* cf. *raibliana*, *Pseudoplacunopsis fissistriata*, *Ostrea montis-caprillis*, *Cassianella* cf. *decussata* in the Middle Triassic beds of the Middle East, North Africa, and Spain (Cox 1924, 1932; Schmidt 1936; Awad 1946; Eicher 1947; Castany *et al.* 1951) contradicts to some extent the accepted idea of faunal migrations from the East to the West of the Mediterranean (cf. Gignoux 1955, p. 279), since the above mentioned species or forms closely allied to them make their appearance in the Alpine region not earlier than at the beginning of the Carnian. The connections which were existing between Spain, North Africa, and the Middle East in Middle Triassic time are proved by the presence of *Gervillia joleaudi* Schmidt in these regions and by occurrence of Spanish forms, e.g. *Placunopsis* cf. *flabellum* Schmidt and *Cassianella* cf. *decussata* (Münster) in Ramon. The mode of occurrence of *Myophoria vulgaris*-*Gervillia joleaudi* assemblage in the Middle Triassic beds of Djebel Chettaba in Algeria (Joleaud 1912, pl. 1; Schmidt 1936, p. 53, pl. 4, fig. 17) is also similar to the occurrence of this same assemblage in Ramon, which characterizes here *Beneckeia*-zone. It may be noted, parenthetically, that species of *Beneckeia* are distributed in the Upper Buntsandstein and Lower Muschelkalk beds of Germany and Upper Silesia; also they were recorded from Bulgaria (Stefanoff 1936*, *vide* Bakalov 1936), Wadi Hesban in Transjordan (Cox 1932), and from a boring at Rekhme in the Northern Negev (Avnimelech 1959). The latter two localities are situated close to Ramon and Araif-el-Naga (Figure 1).

The Carnian fauna of Ramon indicates quite different affinities: with the exception of the world wide occurring *P. discites* (Schlotheim) it is composed of species (p. 5) characteristic of the Alpine province which were not recorded heretofore from Central Europe and were but scarcely recognized in Spain and North Africa. Details of their distribution are given in the part dealing with systematic palaeontology.

It is interesting to note that as a whole the number of the pelecypod species of Alpine affinities increases in Ramon from the Anisian to the Carnian strata. While no species of strictly Alpine relation were recorded from *Beneckeia*-zone, some of such forms occur in the Lower Ladinian *N. laevigatus*-*M. coxi*-zone (*Ostrea montis-caprillis*, *Pseudoplacunopsis fissistriata*, *Cassianella* cf. *decussata*, *Schafhäutlia* aff. *mellingi*, *Gervillia* cf. *bouéi*, *Modiola* cf. *raibliana*), and the Carnian strata are definitely characterized by the predominance of Alpine species.

REMARKS ON PALAEOECOLOGY

The variegated clays, siltstones, and sandstones with abundant plant-remains and thin limestone horizons of the lower part of unit T₁ (Figure 3) may be considered as

having been deposited in a littoral environment. Several specimens of *Lingula* found by Brotzen (1957, p. 196) in this part of the section should indicate, according to him, some locally restricted transgressions. Higher in the section, *Beneckeia*-zone with its definitely marine forms denotes marine conditions caused by an ingressing sea. This was followed by a short regression, after which a new transgressive phase occurred. During this phase a layer of dark limestone, referred to by Brotzen (1957, p. 201) as a "reef" built of *Myalina ramanensis*, was deposited.

This dark limestone attaining a thickness of 4–5 m crops out at a point bearing the coordinates 1388/9997 (Figure 4). Some 300 metres due WSW of this outcrop the

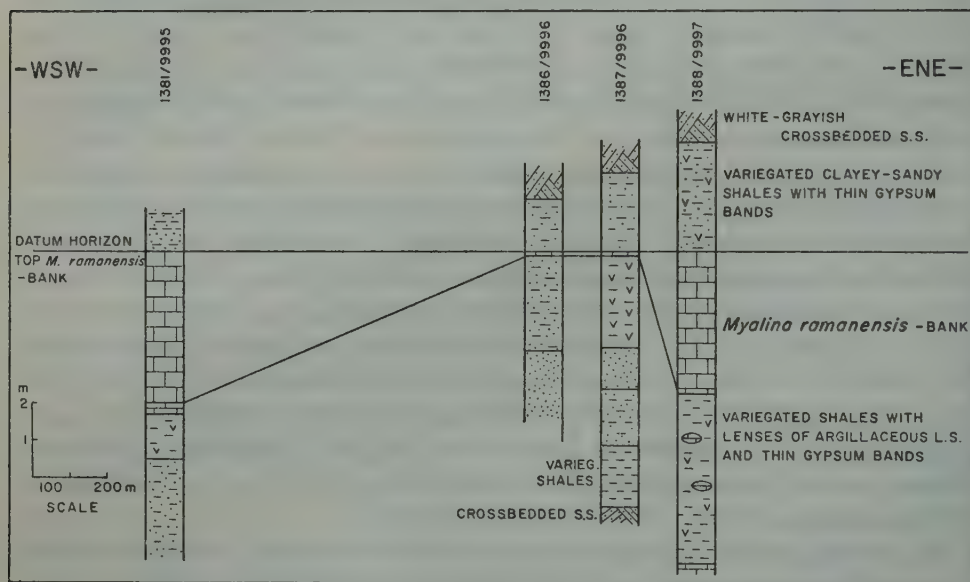


Figure 4
Changes of the thickness of *Myalina ramanensis*-bank, Ramon

bed thins out rapidly to a 0.1 m thick lumachelle underlain by variegated shales and yellowish sandstones. Some 500 meters further in the same direction it attains its former thickness of 4 m. These lateral changes of thickness of the bed might possibly indicate an existence of an elevated sandy-shaly part of the sea bottom with both slopes occupied by populations of *Myalina ramanensis*. The shells belonging to this species are closely packed and very abundant throughout the entire thickness of the bed, and in this sense they somewhat resemble recent mussel-banks. White (1937*, *vide* Kummel 1957, p. 456) has shown that such mussel-banks may attain considerable thicknesses when formed in nearshore, quiet waters. These accumulations of organisms result from the younger generations of *Mytilus* settling down on the buried older ones. The bed with *Myalina ramanensis* Brotzen discussed here might be considered, *pari passu*, as deposited under similar, quiet water conditions. This suggestion is

strengthened by the fact, that most of the shells are found with both valves closed and in a state of relatively good preservation, as compared with several coquina shells found in the section. Since it has been shown (Boucot 1953; Boucot *et al.* 1958) that the degree of disarticulation of the valves in buried assemblages of pelecypods is proportional to the distance of transportation of the shells after their death by water currents, the preservation of the shells of *Myalina ramanensis* should point to their burial *in situ*.

A probable prevalence of quiet-water conditions at the site where *Myalina ramanensis* had been living may be deduced from the following comparison. In the Muschelkalk beds of Ohmgebirge (Hesse) disarticulated heavy valves of *Myalina blezingeri* Philippi were found oriented parallel to bedding planes of the strata (A. H. Müller 1955). This mode of orientation of heavy valves was attributed by him to the activity of strong currents. In contrast to this phenomenon, a lack of orientation of the *Myalina ramanensis* shells, which is particularly clear in the thicker portion of the bank, seems to designate rather quiet waters. The nearshore location of the bank is evidenced by its thickness and by the crossbedded sandstones subjacent and suprajacent to it. (Although McMaster (1958) has described a population of recent *Mytili* living under strong current conditions, in which no preferred orientation of the shells was recorded, but his case, however, is not similar to the one discussed here, as it deals with living molluscs attached to the substratum by means of their *byss*).

A short regressive phase followed the deposition of *Myalina ramanensis*-bank. This in turn was followed by an ingression which resulted in a more stable regime of sea rich in benthonic and free-swimming forms. The finely bedded, alternating limestones and clayey-marly shales of unit T₂ are attributable to sedimentation in a neritic environment.

The 34 m thick sequence of regressive sediments, including *Myalina ramanensis*-bank (Figure 3), intercalated between the Anisian *Beneckeia*-zone and the Lower Ladinian *N. laevigatus*-*M. coxi*-zone, separates to different faunal assemblages. As has been noted earlier, some Alpine species make their first appearance in Ramon only in the Lower Ladinian assemblage.

A similar phenomenon has been described by Carmina Virgili (1955) from the Triassic sequence of the Catalan Coastal Chain. There a faunal assemblage of Central European affinities (*Myophoria intermedia*, *Pleuromya mactroides*, *Ceratites antecedens*) is distributed in the Lower Muschelkalk beds, while some Alpine elements (*Daonella lommeli*, *Cassianella*) appear in the Upper Muschelkalk. Between these marine strata continental Middle Muschelkalk sediments, "tramo rojo", are intercalated. It may be supposed that the changing environmental conditions, connected with the existence of regressive phases, enabled entrance of some alpine species into the neritic seas of the Negev — Sinai area in early Ladinian time, as well as of some other Alpine forms into the seas of North Eastern Spain in middle Ladinian time. As a whole, the assemblage of *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon resembles the Middle Ladinian fauna of Spain (Table 6).

In the neritic seas of the Muschelkalk of Germany several species of sessile pelecypods are known for their tendency to become adhered to the shells of other pelecypods and cephalopods. A case of *Placunopsis* attached to a ceratite shell was described long ago (Philippi 1899a), and communities of *Placunopsis* adhering to the shells of *Pecten laevigatus* (Schlotheim) are also known (Schmidt 1928, p. 158, fig. 338b; Link 1956*, *five Referativnyi Zhurnal*, no. 2, ref. 2102, 1958). An analogous phenomenon is recognized in the *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon. Here a specimen of *Placunopsis* cf. *ostracina* (Schlotheim) has been found attached to a shell of *Hungarites* sp.; *Placunopsis* or *Pseudoplacunopsis* were recorded on a right valve of *Pecten* cf. *laevigatus* (pl. 4, Fig. 12); *Pseudoplacunopsis fissistriata* (Winkler) covering nutilids and ceratites are quite common (pl. 5, figs. 10, 11). It seems that this ecologic niche, occupied in Germany by *Placunopsis*, is at least partly occupied in the Negev by *Pseudoplacunopsis fissistriata*, the species unknown in the Central European Triassic.

With regard to the changing environmental conditions, the sedimentary environment of the *N. laevigatus*-*M. coxi*-zone and *Ps. fissistriata*-zone may be distinguished as "normal marine" (*sensu* Sloss 1953). The sequence of beds overlying *Ps. fissistriata*-zone, viz. the upper part of unit T₃, units T₄ and T₅, which are more dolomitic and contain several gypsiferous intercalations, and are progressively poorer in fauna, may be regarded as deposited under conditions of "penesaline environment". In a similar sense, the gypsum beds of unit T₆ represent a sediment of "saline environment". This development from normal marine through penesaline to saline environment has been named by Sloss (1953) an "advancing restricted hemicycle". The faunal impoverishment of the Upper Ladinian and Carnian strata in Ramon is in accordance with the development of such a hemicycle. However, some other as yet undisclosed factors could have played no less an important role in this process.

PALAEOGEOGRAPHIC SUMMARY

It has recently been noted by Avnimelech (1959) that Ramon lies entirely within the boundaries of the neritic zone of the Triassic epicontinental sea, striking approximately in a SSW-NNE direction and enclosing the Araif-el-Naga and the Wadi Hesban localities. Due SE of the Ramon-Araif-el-Naga line Triassic sandy-dolomitic sediments are exposed in the core of the Mt. Arif (Djebel Ureif, fig. 1) anticline (Bentor and Vroman 1952). However, additional investigations are required before the exact stratigraphic position of these deposits can be determined.

Farther south no marine Triassic is known, and in the Eilat and Timna regions only "Nubian" sandstones are exposed between the marine Lower Palaeozoic and the Cenomanian limestone.

It is difficult to discuss the evolution of the coast-line of the Triassic seas which covered these areas, since the Triassic sediments are known only from a limited number of isolated outcrops. In any case it is noteworthy that a Lower Triassic

fauna was found neither in Ramon nor in Araif-el-Naga, whereas marine purple sandstone deposits of Werfenian age, containing *Claraia*-fauna, are exposed not far away in the Wadi Zerka-Main, on the Eastern shore of the Dead Sea (Cox 1932), and somewhat similar sediments have been recorded due north in North-Western Syria (Henson *et al.* 1949, p. 10), South Eastern Turkey (Tolun 1951; Ten Dam 1955), Northern Caucasus (Robinson 1937) and in the Alpine region. The lowermost part of the Triassic black shales-limestone sequence at Rekhme (Grader 1957) is supposed by Avnimelech (1959) to be of Werfenian age.

In middle Triassic time the coast-line could have been approximately parallel to the Araif-el-Naga-Ramon-Wadi Hesban line, as suggested by mutual resemblance of the faunal assemblages recorded from these localities (Table 6). After rather uniform Middle Triassic marine sedimentation in the Ramon-Araif-el-Naga area, epeirogenic movements in Carnian time apparently resulted in a different deposition of sediments in these two localities. These movements could have been responsible, as well, for the faunal impoverishment of the Upper Triassic sea in these regions.

SYSTEMATIC PALAEONTOLOGY

Registration numbers prefixed *HU* indicate the specimens deposited in the Palaeontological Collection of the Department of Geology, Hebrew University. Those prefixed *M* are in the keeping of the Geological Survey of Israel, Jerusalem. The general distribution of the species was compiled from Diener (1923) and Kutassy (1931), unless otherwise specified.

Family LEDIDAE Adams

Genus *Leda* Schumacher 1817

Leda cf. *fibula* Mansuy 1912

Pl. 1, figs. 1-3.

Cf. *Leda fibula* Mansuy 1912, p. 47, pl. 9, fig. 10.

Material: internal moulds (HU 20407).

This species resembles *L. fibula* described by Mansuy from the Upper Triassic beds of Dien-Bien-Phu. However, some morphological details of the specimens from Ramon are slightly different: their umbons are situated more posteriorly and the valves lack a pronounced concavity of the ventral margin, which is characteristic, of the Indo-Chinese species. *Leda* cf. *fibula* differs from *L. nagaensis* Awad (1946 p. 409, pl. 2, fig. 4) in its larger length/height ratio (which is approximately 2:1 in Awad's species) and in narrower posterior portion of the shell.

Dimensions: length 11 17-18 mm
 height 4 6-7 mm

Distribution: upper horizons of *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon.

Family CTENODONTIDAE Woehrmann

Genus *Palaeoneilo* Hall 1869*Palaeoneilo elliptica* (Goldfuss 1840)

Pl. 1, figs. 4, 5.

Nucula elliptica Goldfuss 1840, p. 153, pl. 124, fig. 16.*Palaeoneilo elliptica* (Goldfuss); Bittner 1895, p. 142, pl. 16, figs. 26–31.*Palaeoneilo elliptica* (Goldfuss); Waagen 1907, p. 104, pl. 34, fig. 26.Cf. *Ctenodonta elliptica* (Goldfuss) var. *praecursor* Frech 1912, p. 11, fig. 3.*Nucula elliptica* Goldfuss; Schmidt 1928, p. 174, fig. 389.*Palaeoneilo elliptica* (Goldfuss); Leonardi 1943, p. 43, pl. 7, figs. 23–25.*Leda elliptica* (Goldfuss); Awad 1946, p. 409, pl. 2, fig. 3.

Material: numerous internal moulds and fragments of shells embedded in hard limestone matrix (HU 20402, 20403).

As far as no chondrophore is present in the hinge structure of the specimens discussed here, they should be referred to genus *Palaeoneilo* rather than to *Leda*. The outline of the shells is closely similar to that figured by Goldfuss, Waagen, and Leonardi (*opp. cit.*), but it differs slightly from the contours of St. Cassian specimens (Bittner *op. cit.*) whose postero-dorsal margins are nearly horizontal and lunulas deeper.

Dimensions of plesiotypes: maximum length — 14 mm, maximum height — 7 mm, apical angle — ca. 130°.

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon; "luma-chelle series" of Araif-el-Naga (Awad 1946); Muschelkalk and Lettenkohle of Germany; Werfenian to Carnian of the Southern Alps; Anisian and Carnian of the Bakony Forest; Carnian of Sicily; Middle Ladinian of Spain (Schmidt 1936); Upper Triassic of Tripolitania (Parona 1914*, *vide* Lipparini 1940, p. 230). This species has been recorded also from the base of Norian in Darlac (Saurin 1935), and an allied form (*P. aff. elliptica*) has been found in the Triassic of Yun-Nan, Southern China (F. R. C. Reed 1924).

Family MYOPHORIIDAE Cox

Genus *Myophoria* Bronn 1837 *partim* Cox 1951*Myophoria vulgaris* (Schlotheim 1820)

Pl. 1, fig. 7.

Trigonellites vulgaris Scholtheim 1820*, p. 192.*Lyrodon vulgare* Goldfuss 1840, p. 198, pl. 135, fig. 16.*Myophoria vulgaris* (Schlotheim); Philippi 1905, pl. 5, fig. 7.*Myophoria vulgaris* (Schlotheim); Schmidt 1928, p. 189, fig. 441.

Material: four specimens and several internal moulds (HU 20381, 20382).

Measurement of Seebach's Ratio of the valves present yielded the following results: 1:2.40, 1:2.45, 1:2.30, 1:2.25. These values fall within the 1:2.24 — 1:2.79

range accepted for *M. vulgaris* (Schmidt 1928). The length/height ratio of these specimens is 1.07 — 1.12 which also fits the accepted 1.05 — 1.22 range.

Distribution: *Beneckeia*-zone (Anisian) of Ramon; Röt to Lettenkohle of Germany; Röt dolomit to Upper Muschelkalk of Upper Silesia (Assmann 1937); Muschelkalk of Świetły Krzyż Mts. (Senkowiczowa 1956–7); Middle Buntsandstein and Anisian of Spain; Middle Triassic of Algeria and Tunisia (Joleaud 1912; Flandrin 1932; Castany *et al.* 1951); Upper Anisian of Plouk, Eastern Cambodia (Saurin 1935); Middle and Upper Triassic of Madagascar (Collignon 1954).

Myophoria intermedia Schaubroth 1857

Pl. 1, fig. 6.

Myophoria intermedia Schaubroth 1857*, p. 127, pl. 7, fig. 3.

Myophoria intermedia Schaubroth; Cox 1924, p. 80.

Myophoria intermedia Schaubroth; Schmidt 1928, p. 188, fig. 439.

Three specimens (M 3424) of *Myophoria* displaying Seebach's Ratio of 1:3.8 — 1:4.0 belong to this species.

Dimensions of plesiotypes: length 18 19 12 mm

height 17 17 10 mm

Distribution: top of *Beneckeia*-zone (Anisian) of Ramon; Muschelkalk and Keuper of Germany; Upper Muschelkalk of the Kanton Aargau (Herb 1957); Anisian of Spain; Middle or Upper Triassic of Transjordan (Cox 1924).

Myophoria elegans (Dunker 1849)

Pl. 1, fig. 8.

Lyriodon elegans Dunker 1849*, p. 15.

Myophoria elegans (Dunker); Philippi 1905, pl. 5, fig. 8.

Myophoria elegans (Dunker); Schmidt 1928, p. 193, fig. 455.

Myophoria elegans (Dunker); Leonardi 1935, p. 46, pl. 2, fig. 7.

Myophoria cf. elegans (Dunker); Schmidt 1936, p. 83, pl. 5, fig. 35.

Myophoria elegans (Dunker); Awad 1946, p. 416, pl. 3, fig. 16.

Material: five specimens (HU 20404–6).

These specimens are apparently identical with those of *Myophoria elegans* as described by the authors cited above. Shells belonging to this species can be distinguished from a somewhat similar Rhaetian *M. inflata* Emmerich (= *postera* Quenstedt) in being less elongated and lacking the trifurcating ribs of *M. inflata* Emm. (Benecke 1900). Compared with a Carnian *M. heslingtonensis* Trechmann from New Zealand (Marwick 1953, p. 52, pl. 4, fig. 7), the specimens of *M. elegans* (Dunker) from Ramon possess less curved areal carines and more numerous concentric ribs.

Dimensions of plesiotypes: length 20 — 7

height 19 19 5.5

number of ribs 42 30 16

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon; "luma-chelle series" of Araif-el-Naga (Awad 1946); Röt to Keuper of Germany; Middle and Upper Muschelkalk of Upper Silesia (Assmann 1937); Anisian of the Southern Alps and Bakony Forest; Werfenian of the Venetian Alps: Middle Ladinian of Spain (Schmidt 1936); Muschelkalk and Carnian (?) of Yun-Nan, Southern China. A form regarded by Avnimelech (1957, 1959) as *M. elegans*? has been found together with *Beneckeia wogauana* (Meyer) in a boring at Rekhme, Northern Negev, Southern Israel.

Myophoria germanica Hohenstein 1913

Pl. 1, figs. 9–11.

Myophoria germanica Hohenstein 1913, p. 59, pl. 2, figs. 5–8.

Myophoria germanica Hohenstein; Schmidt 1928, p. 188, fig. 437.

Myophoria germanica Hohenstein; Awad 1946, p. 416, pl. 2, figs. 1, 8.

Material: about thirty specimens (HU 20408/1–3, 20409–11; M 3426/1, 3404/2).

Among the specimens which closely agree with the description and figures of *M. germanica* given by the above mentioned authors, several shells deviating from the original type occur. These are characterized by a somewhat rounded areal carine which curves posteriorly near the ventral margin of the shell. This curved carine makes the specimens related to *M. elegans* (Dunker), but inasmuch as neither the concentric ribs nor the rounded prae-carinal furrow characteristic of *M. elegans* are present here, it seems preferable to regard these specimens as varietal types of *M. germanica*. A slight curvature of the areal carine, similar to that of the specimens discussed here, is observable on the left valve of *M. cf. simplex* (Schlothheim) from the Werfenian of the Southern Alps (Philipp 1904, p. 54, pl. 2, fig. 5), but the carine itself is less prominent and less acute in the specimens from Ramon.

Dimensions of plesiotypes: length 7 to 18 mm

height 6 to 14 mm

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon and Araif-el-Naga; Middle and Upper Muschelkalk of Germany (Schmidt 1928); Muschelkalk of Algeria (Glangeaud 1952).

Myophoria woehrmanni Bittner 1895

Pl. 1, figs. 12, 13.

Myophoria woehrmanni Bittner 1895, p. 106, pl. 12, figs. 9–13.

Myophoria woehrmanni Bittner; Bittner 1912, p. 16, pl. 7, fig. 3.

Myophoria decussata (Münster) var. *woehrmanni* Bittner; Leonardi 1943, p. 50, pl. 8, figs. 20, 21.

Material: about fifteen specimens, embedded in part in a limestone matrix (HU 20412–20418).

Specimens of *Myophoria* apparently identical with those described by Bittner and

Leonardi (opp. cit.) as *M. woehrmanni* and *M. decussata* var. *woehrmanni* occur in the examined material. They are characterized by a concave area, a prominent areal carine, and four-five radial plicae occupying the surface of the valves. These plicae start near the umbons and die out within the upper half of the valve. In addition, the shells are ornamented by fine concentric ribs which become thinner and more numerous on the area. A weak radial rib is present on the area of the specimens from St. Cassian (Bittner 1895), but no such ribs are observable on the area of the specimens from the Bakony Forest (Bittner 1912) and Ramon.

Dimensions of plesiotypes: length 9 — 18 mm
height 8 — 16 mm

Distribution: *Clionites*-bed (Lower Carnian) and *Avicula aspera*-bed (Lower or Middle Carnian) of Ramon; Lower Carnian of the Southern Alps, Bakony Forest, Northern Italy, Sicily; Upper Triassic of Tripolitania (Parona 1914*, *fide* Lipparini 1940, p. 230).

Myophoria coxi Awad 1946
Pl. 1, figs. 16–19.

Myophoria coxi Awad 1946, p. 413, pl. 2, figs. 5, 6*a-e*.

Material: thirty specimens (HU 20393–20400, 20534, 20540; M 3404/3, 3412/1, 3413/2, 3414/1).

Describing this species Awad (*op. cit.*) introduced a so called “2-nd ratio” which is the ratio of the distance between the areal carine and the first extra-areal rib to the distance between the first and the second extra-areal ribs. This ratio was measured by Awad (*op. cit.*, p. 415) on six specimens of *M. coxi* from Araif-el-Naga and has been shown to vary from 2.6:1 to 3.3:1. Seebach’s Ratio for the same specimens is given by Awad as varying from 1:2 to 1:2.6

The length, Seebach’s Ratio (SR), and Awad’s “2-nd ratio” (AR) were measured by the present author for fifteen specimens collected in Ramon and for five from Araif-el-Naga. The results of these measurements are summarized in Tables 1, 2.

TABLE 1

AR	2.8	2.8	3.0	2.2	2.8	2.0	2.3	3.0	1.9	2.8	3.0	2.5	3.3	2.7	3.0
SR 1:	—	—	—	—	—	2.6	—	2.4	—	—	2.2	2.5	2.1	2.0	—
Length mm	33	32	39	28	—	35	40	26	33	40	18	55	42	22	40

Table 1. Length, Seebach’s Ratio, and Awad’s “2-nd ratio” of fifteen specimens collected in Ramon.

TABLE 2

AR	2.3	2.0	2.1	2.7	3.3
SR 1:	2.2	2.2	3.0	2.3	—
Length mm	36	32	35	31	—

Table 2. Length, Seebach’s Ratio, and Awad’s “2-nd ratio” of five specimens collected in Araif-el-Naga (HU 20534, 20540).

As shown on Tables 1, 2, the length of the measured specimens varies from 18 mm to 55 mm, Seebach's Ratio varies from 1:2.0 to 1:3.0, and Awad's Ratio — from 1.9:1 to 3.3:1. Comparing the values of Awad's Ratio with the corresponding values of length it seems that no direct interrelationship exists between these two parameters, since Awad's Ratio varies independently of shell-size.

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon and Araif-el-Naga.

Myophoria multicostata sp. nov.

Pl. 2, figs. 1-6.

Holotype: HU 20419/51.

Paratypes: HU 20419/1-50, 20419/52-111.

Locus typicus: Ramon, coord. 13860/99985.

Stratum typicum: base of *N. laevigatus*-*M. coxi*-zone (Figure 3).

Derivatio nominis: from *multus* = many, *costata* = ribbed.

Material: about 180 specimens.

Description. The shells are triangular in outline, inequivalve, and variably inequilateral. The umbons are slightly prosogyrous. The ornamentation of the right valve consists of 5-7 ribs which extend from the umbo to the ventral margin. The interspaces are narrow, flat or slightly round-bottomed. A wider furrow is formed between the two last ribs in the posterior of this valve. (Hereinafter referred to as the "main furrow"). An acute rib subdivides the area of this valve into two parts.

The left valve is ornamented by 5-7 primary ribs; somewhat shorter secondary and tertiary ribs run in the interspaces between the primary ones. The main furrow is either smooth or ornamented by 1-4 fine secondary ribs.

In this latter case the entire number of ribs may attain a value of 12-13. The area of the left valve is subdivided into two by a sharp rib; the inner part is ornamented by 2-4 very thin ribs which extend from the umbo to the postero-dorsal margin of the valve.

Dimensions of holotype: length 13 mm, height 13 mm, inflation of both valves 8.5 mm.

Dimensions of paratypes: length 8 — 18 mm; length/height ratio is close to 1:1. The variation of this ratio, as measured on forty-nine specimens, is given in Figure 5.

Discussion. The specimens described here as *M. multicostata* are somewhat similar in shape to *M. malayensis* Newton (1900, p. 134, pl. 12, fig. 15) from the Upper Triassic of Malayan Province, but the shells of the latter species lack the characteristic main furrow. The species from Ramon is also comparable with *M.*

tennei Dames from the Carnian of the Bear Islands (Boehm 1903, p. 42, pl. 4, figs. 23, 26, 28–30). However, the main furrow of *M. multicostata* is considerably narrower, its ribs are less prominent and more acute in cross-section.

On the grounds of strong variability of the number of ribs, as well as of varying location of the secondary ribs with regard to the main and other furrows, it may be questioned whether it is justifiable to assign all the specimens to one species. It might seem reasonable to separate taxonomically the specimens with the smooth main furrows from the specimens with the ribbed main furrows.

The forthcoming discussion is an attempt to show that neither specific nor infra-specific distinction can be drawn between the two mentioned classes of specimens.

The number of ribs seems not to be a function of the size of a shell. As shown in Figure 6, smaller specimens with as many as 10 ribs and larger ones with as few as 6 ribs occur in the studied sample. The smaller and the larger specimens equally possess or are devoid of ribs in the main furrow.

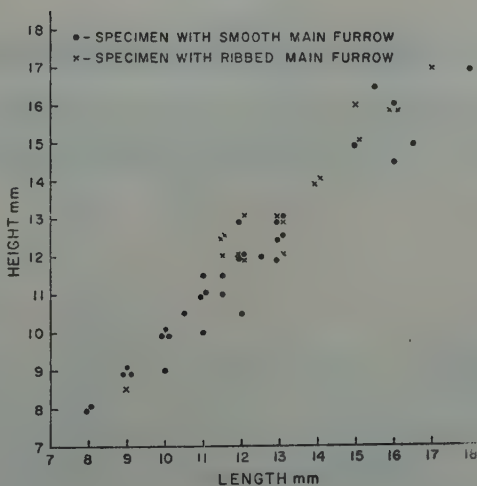


Figure 5
Variation of the length: height ratio of the shells.

The number of ribs of each of 111 left valves collected from one 20 cm thick bed at the base of unit T₂ was counted, and frequency curves (number of specimens plotted against a number of ribs) were drawn separately for 71 specimens with smooth main furrows and for 40 specimens with ribbed main furrows (Figure 7). The degree of non-overlap displayed by the curves is far less than the values accepted (Mayr *et al.* 1953, pp. 143–4; Sylvester-Bradley 1958, p. 223) for specific or subspecific separation. In the present case only 15.41% of the valves with the

smooth main furrows (curve A, Figure 7) and 12.68% of the valves with the ribbed main furrows (curve B, Figure 7) do not have the same number of ribs. If the ribs

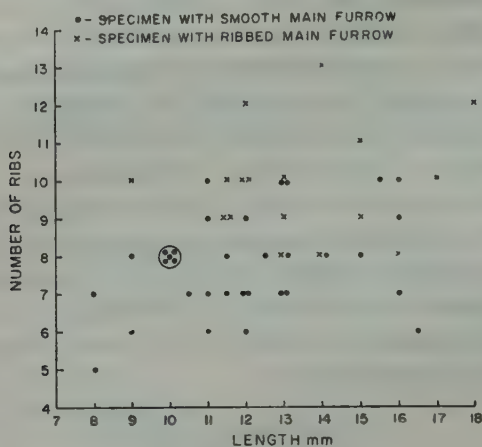


Figure 6
Variation of the number of ribs with the varying length of the shell.

which run along the main furrows are left uncounted, the distribution of the numbers of ribs in both parts of the sample becomes nearly identical (Figure 8). It seems,

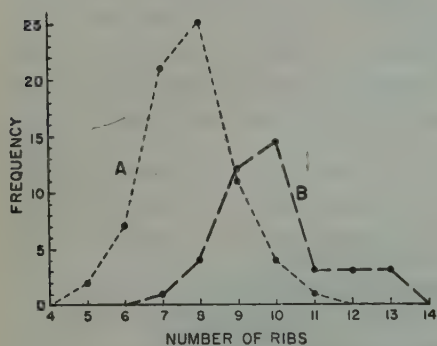


Figure 7
Frequency distribution diagram showing the number of specimens (frequency) vs. the total number of ribs of each specimen.
Curve A—specimens with the main furrows smooth.
Curve B—specimens with the main furrows ribbed.

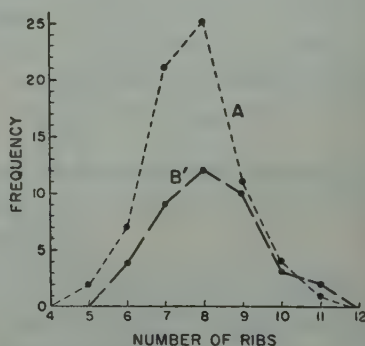


Figure 8
Frequency distribution diagram. Curve A—specimens with the main furrows smooth. Curve B'—specimens with the main furrows ribbed (here the ribs in the main furrows were left uncounted and, consequently, the range of the numbers of ribs was displaced to the left).

therefore, that the appearance of ribs in the main furrow of some specimens should be attributed to intraspecific variability.

In order to find out whether the observed results, i.e. the established ratio (71:40)

of the valves with the main furrows smooth to those with the main furrows ribbed in the analysed sample is or is not due to chance, the χ^2 -test (*chi square*) was applied. χ^2 was calculated in a way proposed by Sylvester-Bradley (1958, p. 218), and for details the reader is referred to that work.

$$\chi^2 = \frac{\sum g - nG}{G(1-G)} \quad (1)$$

where the values of G and g are derived as shown in Table 3.

TABLE 3
(after Sylvester-Bradley 1958, Table 2)

Collections	Morphotypes				Totals
	α	β	γ	δ	
X	a	b	c	d	n
Y	A	B	C	D	N
Totals	$a + A$	$b + B$	$c + C$	$d + D$	$n + N$
	a^2	b^2	c^2	d^2	
g	$\frac{a^2}{a + A}$	$\frac{b^2}{b + B}$	$\frac{c^2}{c + C}$	$\frac{d^2}{d + D}$	Σg
	$a + A$	$b + B$	$c + C$	$d + D$	
					n
G					$\frac{n}{n + N}$

The specimens with 5, 6, 7, etc., ribs were selected as morphotypes. The specimens with smooth and ribbed main furrows were assigned to the collections X and Y , respectively. The observed frequencies of the morphotypes belonging to each of the collections (a, b, A, B , etc.) are summarized in Table 4.

TABLE 4

Collections	Morphotypes									Totals
	5	6	7	8	9	10	11	12	13	
X	2	7	21	25	11	4	1	0	0	71
Y	0	0	1	4	12	14	3	3	3	40
Totals	2	7	22	29	23	18	4	3	3	111

Since the values of the expected frequency $E = n(a + A)/(n + N)$ are less than 5 in some of the cells (a, b , etc.), the neighbouring vertical columns (morphotypes)

should be united until $E > 5$ is reached. The results of this are presented in Table 5, and the values of G and g are derivable therefrom.

TABLE 5

Collections	Morphotypes						Totals
	5 + 6	7	8	9	10	11 + 12 + 13	
X	9	21	25	11	4	1	71
Y	0	1	4	12	14	9	40
Totals	9	22	29	23	18	10	111

$$\Sigma g = 56.85 \quad G = 0.6396$$

After substitution of the values of G and g in the formula (1) χ^2 can be calculated:

$$\chi^2 = \frac{56.85 - 71 \times 0.6396}{0.6396(1 - 0.6396)} = \frac{11.433}{0.2305} = 49.6008$$

For the value of $\chi^2 = 49.6008$ with 5 degrees of freedom (the number of morphotypes less one) the corresponding probability P is far below 0.01 (Fisher and Yates 1948). Consequently, the probability that the observed ratio of the specimens in the analysed sample (71:40) is merely due to chance is less than 0.01. Calculating the standard error of the proportions

$$s = \sqrt{\frac{p(1-p)}{N}} = \sqrt{\frac{0.6396 \times 0.3604}{111}} = \pm 0.046 = \pm 4.6\%$$

where p is the proportion of the specimens with smooth main furrows, it may be deduced that a population of *M. multicostata* probably consisted of

63.96% $\pm 2 \times 4.6\%$ of the specimens with smooth main furrows and

36.04% $\pm 2 \times 4.6\%$ of the specimens with ribbed main furrows, which makes 73%-55% and 25%-45%, respectively.

Distribution: the base, 20 cm thick limestone bed of *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon; rare in the upper horizons of this zone.

Myophoria sp. ind.

Pl. 2, fig. 8, 9.

Material: three internal moulds (M 3425).

The specimens are small, 5×5 mm and 6.5×6.5 mm, ornamented by 5–7 slightly crest rounded, roof shaped ribs. The ribs are gently curved toward the anterior margin of the shell. One measurement of Seebach's Ratio gave a value of 1:3. Awad's "2-nd ratio" is 1.9 – 2.2, as measured on three moulds.

This species bears some morphological similarity to *M. coxi* Awad (p. 28), but it differs from the latter in its much smaller dimensions and less acute ribs. *Myophoria* sp. ind. is distinguishable from *M. rivai* (Tommasi) from the Norian of Northern Italy (Mazzoca 1942, p. 212, pl. 3, figs. 5–9) by its smaller length/height ratio and less prominent ribs. As compared with *M. mollucana* Wanner (1952, p. 79, pl. 4, figs. 9a, b) from the Triassic of Seran, the specimens of *Myophoria* sp. ind. from Ramon are more inequilateral and ornamented by fewer ribs.

Distribution: upper *Spiriferina lipoldi*-bed (Carnian) of Ramon.

? *Myophoria* sp.

Pl. 2, fig. 7.

Material: one left valve (HU 20486) and one mould (M 3430).

A very flat left valve ornamented by approximately ten subrounded concentric ribs. A smooth area of the valve is bordered anteriorly by an acute, low areal carine. Inasmuch as no hinge was preserved its relation to the genus *Myophoria* is uncertain. This specimen resembles *Myophoria* cf. *urd*? Boehm recorded by Schmidt (1936, p. 84, fig. 22) from the Keuperdolomit of Spain, but the material described here is too fragmentary to make any further comparison possible.

Dimensions: length ca. 22 mm

height ca. 13 mm

Distribution: lower *Spiriferina lipoldi*-bed (Carnian) of Ramon.

Genus *Myophoriopsis* Woehrmann 1889

Cf. *Myophoriopsis subundata* (Schauroth 1855)

Pl. 2, figs. 10–13.

Cf. *Tapes subundata* Schauroth 1855, p. 516, pl. 2, fig. 7.

Cf. *Myophoriopsis sandbergeri* Philippi; Hohenstein 1913, p. 65, pl. 2, fig. 17, pl. 3, figs. 2, 6–11.

Cf. *Myophoriopsis subundata* (Schauroth); Assmann 1937, p. 37, pl. 8, fig. 20.

Cf. *Myophoriopsis subundata* (Schauroth); Awad 1946, p. 419, pl. 2, fig. 10.

Material: about twenty specimens (HU 20420–20422; 20769; M 3426/2–3, 3431/1–4).

The shape of the shells of these specimens generally agrees with that described and figured by the above mentioned authors, although the angle between the postero-dorsal and the ventral margins of the present specimens is slightly more acute than the corresponding angle of the specimens from Schwarzwald (Hohenstein *op. cit.*). While the shells examined are ornamented only by fine concentric growth lines,

distinct thin radial striae ornament the right valve of *M. subundata* recorded by Assmann (op. cit.) from the Muschelkalk of Upper Silesia.

Dimensions: length 8 — 18 mm
height 6 — 12 mm

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon and Araif-el-Naga; *Ps. fissistriata*-zone (Middle to Upper Ladinian) of Ramon.

M. subundata has been recorded from the Muschelkalk of Upper Silesia and Sardinia; Muschelkalk to Grenzdolomit of Germany; Middle Ladinian of Spain (Schmidt 1936). An allied form, *M. cf. sandbergeri* Philippi, has been identified by Fallot (1942) from the Muschelkalk of Algeria.

Genus *Neoschizodus* Giebel 1856
Neoschizodus laevigatus (Ziethen 1830)
Pl. 2, figs. 14, 15.

Trigonia laevigata Ziethen 1830*, p. 94, pl. 71, figs. 2, 6.
Myophoria laevigata (Ziethen); Frech 1889, p. 134, pl. 11, fig. 3.
Myophoria laevigata (Ziethen); Philippi 1905, pl. 5, figs. 9a, b.
Myophoria laevigata (Ziethen); Frech 1912a, p. 38, pl. 7, fig. 4.
Myophoria laevigata (Ziethen); Schmidt 1936, p. 74, pl. 5, fig. 25.

Material: seventeen specimens (HU 20385–20390, 20452, 20494, 20535; M 3404/1 3406/3, 3426/4).

According to Cox (1951), the smooth shells of MYOPHORIIDAE are to be referred to the genus *Neoschizodus*.

Dimensions of plesiotypes: length 26 — 60 mm
height 25 — 55 mm

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon and Araif-el-Naga; Werfenian of the Bakony Forest, Venetian Alps (Leonardi 1935), Western Balkans (Bešić 1950), Slovakia (Mahel 1959), Bukhara and Ussuri provinces of Russia, Salt Range; Werfenian to Ladinian of the Southern Alps; Norian of Budapest region; Röt to Grenzdolomit of Germany; Rötdolomit to Upper Muschelkalk of Upper Silesia (Assmann 1937); Middle Ladinian of Spain (Schmidt 1936); Middle Triassic of Tunisia (Castany *et al.* 1951); Werfenian of the Wadi Zerka-Main, and higher strata of the Wadi Hesban in Transjordan (Cox, 1924, 1932); Upper Anisian of Plouk (Saurin 1935), and the Triassic of Laos and Tonkin; Middle Carnian to Norian of Japan (Kambe 1951, 1957); Ladinian of Nevada (S. W. Muller and Ferguson 1939).

Neoschizodus orbicularis (Bronn 1837)
Pl. 1, figs. 14, 15.

Myophoria orbicularis Bronn 1837, pl. 13, fig. 11; 1851, p. 72.
Lyrodon orbicularis (Bronn); Goldfuss 1840, p. 196, pl. 135, fig. 10.

Lucina plebeja Giebel 1856, p. 49, pl. 3, fig. 5.

Myophoria orbicularis Bronn; Alberti 1864, p. 118, pl. 4, fig. 2.

Myophoria orbicularis Bronn; Philippi 1905, pl. 5, fig. 12.

Myophoria orbicularis Bronn; Ogilvie-Gordon 1927, p. 34. pl. 3, figs. 6, 7.

Myophoria orbicularis Bronn; Schmidt 1928, p. 187, fig. 433.

Material: three internal moulds (HU 20391, 20392; M 3403).

The examined specimens are somewhat smaller than the average described by Bronn, Goldfuss, Alberti (*opp. cit.*) and are therefore closer to the forms figured by Giebel, Ogilvie-Gordon, and Schmidt (*opp. cit.*).

Dimensions of plesiotypes: length 8 11.5 12.3 mm
height 7.4 10.5 11.3 mm

Distribution: *Beneckeia*-zone (Anisian) of Ramon; Buntsandstein of the Balearic IIs.; Lower Muschelkalk of Aragon, Germany, and Upper Silesia; Anisian of the Southern Alps. A Norian variety, *N. orbicularis* (Bronn) var. *nana*, has been described by Conti (1952) as a *nomen nudum*.

Family CARDINIIDAE Zittel

Genus *Trigonodus* Sandberger 1864

Trigonodus tenuidentatus sp. nov.

Pl. 2, figs. 19–21.

Holotype: HU 20423/1.

Paratypes: HU 20423/2–4, 20424.

Locus typicus: Ramon, coord. 13896/99972.

Stratum typicum: *Beneckeia*-zone.

Derivatio nominis: from *tenuis* = thin, *dentatus* = toothed.

Material: about thirty-five specimens.

Description. Shell rounded, trapezoidal; area flat; anterior margin fairly rounded; angle between straight postero-dorsal margin and arcuate ventral margin 55°–65°; lunula very small; umbons moderately prosogyrous, slightly salient; ornamentation consists of numerous concentric growth lines. The structure of the hinge is

3a, 1, PIII
—
AII, 2a, 2b, PII, IV

Dimensions of holotype: length 29 mm
height 22 mm
inflation (left valve) 9 mm

Dimensions of paratypes: length 22 — 37 mm
height 16 — 26 mm

Length/height ratio has been measured for twenty-eight paratypes and the standard deviation of the mean value calculated: Mean L:H — 1.28, standard deviation — 0.085. The ratio of the length of the area to its width is 3.82 with the standard deviation of 0.24, as obtained from six measurements.

Hinge angle: 120°–126°.

Remarks. The contour of the shell of the present species is similar to that of *Trigonodus sandbergeri* Alberti var. *dalmatina* Waagen (1907, p. 127, pl. 33, figs. 6–9) from the Middle Muschelkalk of Dalmatia, but the length/height ratio is smaller in the Ramon species and its teeth are thinner and placed closer to the hinge margin. The structural pattern of the hinge of the present species resembles that of *T. rablensis* (Gredler) from the Carnian of the Southern Alps (Waagen, *op. cit.*). However, the dimensions of the shell and the hinge angle of *T. tenuidentatus* sp. nov. are considerably smaller.

Distribution: *Beneckeia*-zone (Anisian) of Ramon.

Family SPONDYLIDAE Gray

Genus *Plicatula* Lamarck 1801

Subgenus *Pseudoplacunopsis* Bittner 1895

Plicatula (*Pseudoplacunopsis*) *fissistriata* (Winkler 1861)

Pl. 2, figs. 17, 18.

Anomia fissistriata Winkler 1861, p. 467, pl. 5, fig. 10.

Plicatula (*Pseudoplacunopsis*) *fissistriata* (Winkler); Cox 1924, p. 67, pl. 1, figs. 13, 14.

Plicatula (*Pseudoplacunopsis*) *fissistriata* (Winkler); Awad 1946, p. 422, pl. 3, fig. 9.

Material: about forty specimens (HU 20425–20427, 20488, 20537; M 3404/4, 3426/9, 3429, 3431/5).

The shape and the ornamentation of this species closely resemble that of *Placunopsis plana* Giebel (1856, p. 13, pl. 2, fig. 6; Schmidt 1928, p. 165, fig. 358) and it is on the basis of the structure of the hinge only that a certain distinction can be drawn between these two species. It seems, however, that the radial ornamentation and the growth lamellae of *Pseudoplacunopsis fissistriata* are coarser than the average of *Placunopsis plana*.

Dimensions of plesiotypes: maximum length 32 mm

maximum height 32 mm

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) and *Ps. fissistriata*-zone (Middle to Upper Ladinian) of Ramon and Araif-el-Naga; *Clionites*-bed (Lower Carnian) of Ramon; Middle or Upper Triassic beds of Transjordan (Cox 1924, 1932); Carnian and Norian of the Alps; Norian of Sumatra.

Genus *Enantiostreon* Bittner 1895*Enantiostreon difforme* (Schlotheim 1823)

Pl. 3, fig. 1.

Ostracites crista-diformis Schlotheim 1823*, pl. 36, fig. 2.*Enantiostreon difforme* (Schlotheim); Frech 1912a, p. 33, pl. 5, fig. 2.*Enantiostreon difforme* (Schlotheim); Schmidt 1936, p. 66, pl. 4, figs. 36-38.*Enantiostreon difforme* (Schlotheim); Awad 1946, p. 412, pl. 2, fig. 14.

Material: eight specimens (HU 20428-20432; M 3406/2, 3407/2, 3411/1).

Irregular, inequilateral shells, ostreiform in appearance, ornamented by 12-18 strong plicae belong to this species. Although no specimens with adductor scars preserved were found, the elliptical area of attachment situated near the opisthogyrous umbo of the right valve enables the identification of these specimens as *E. difforme*. The mode of attachment by right valve makes them distinguishable from *Ostrea montis-caprilis* Klipstein.

Dimensions of plesiotypes: maximum length 24 mm

maximum height 23 mm

Distribution: *Beneckeia*-zone (Anisian) of Ramon; *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon and Araif-el-Naga; Röt to Muschelkalk of Germany; Röt dolomit to Muschelkalk of Upper Silesia (Assmann 1937); Middle Ladinian of Spain (Schmidt 1936); Middle Triassic of Tunisia (Castany *et al.* 1951); Carnian of Yun-Nan, Southern China.

Family *Anomiidae* GrayGenus *Placunopsis* Morris and Lycett 1853*Placunopsis cf. ostracina* (Schlotheim 1820)

Pl. 2, fig. 16

Cf. Chamites ostracites Schlotheim 1820*, p. 215.*Cf. Placunopsis ostracina* (Schlotheim); Schmidt 1928, p. 164, figs. 357-8.*Placunopsis cf. ostracina* (Schlotheim); Schmidt 1936, p. 65, pl. 5, figs. 8, 9.

Material: two valves and two moulds attached to an ammonite shell (HU 20453, 20485).

Small rounded shells with edentulous hinge, ornamented by fine concentric growth lines and very weak radial striae are closely similar to a specimen of *Pl. cf. ostracina* recorded by Schmidt (1936), while they differ from a smooth, unstriated specimen of *Pl. cf. ostracina* described by Cox (1924, p. 68) from the Triassic of the Wadi Ayun-Musa. With regard to the weak ornamentation of the specimens from Ramon and Araif-el-Naga, they are closer to *Pl. ostracina* than to an allied *Pl. plana* Giebel.

Schmidt (1928, p. 165) included these two species under one — *Pl. ostracina*, while Assmann (1937, p. 60) emphasized the difference between them as evidenced by the types of ornamentation.

Dimensions: 1.5×1.5 , 3.5×3.5 , 12×12 , 13×13 mm.

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon and Araif-el-Naga; Middle or Upper Triassic of Transjordan (Cox 1924); Muschelkalk and Lettenkohle of Germany; Muschelkalk of Upper Silesia (Assmann 1937); Anisian of the Southern Alps; Middle Ladinian of Spain (Schmidt 1936).

Placunopsis cf. *flabellum* Schmidt 1936

Pl. 2, fig. 22.

Cf. *Placunopsis flabellum* Schmidt 1936, p. 64, pl. 5, figs. 4-7.

Material: two upper valves (HU 20454/1,2).

The specimens collected in Ramon resemble the free valves of *Pl. flabellum*, although they are slightly larger than the material figured by Schmidt (op. cit.). The valves, elliptical in contour, are higher than long and are ornamented by acute, roof-shaped ribs. Six-eight primary ribs radiate from the umbo, and in the course of their growth secondary and tertiary ribs branch off from the primary ones. The height of the ribs decreases gradually from the centre of the valve outward.

Dimensions: length 32 25 mm

height 39 30 mm

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon. *Pl. flabellum* has been described by Schmidt (1936) from the Middle Ladinian of Spain.

Family OSTREIDAE Lamarck

Genus *Ostrea* Linné 1758

Ostrea montis-caprilis Klipstein 1845

Pl. 3, fig. 2.

Ostrea montis-caprilis Klipstein 1845, p. 247, pl. 16, fig. 5.

Ostrea montis-caprilis Klipstein; Arthaber 1906, pl. 42, figs. 8, 9.

Ostrea montis-caprilis Klipstein; Bittner 1912, p. 74, pl. 6, figs. 14-18.

Ostrea montis-caprilis Klipstein; Frech 1912a p. 31, pl. 5, fig. 1.

Ostrea montis-caprilis Klipstein; Cox 1924, p. 65, pl. 1, figs. 9-11.

Material: five specimens (HU 20433-20435).

The location of the area of attachment on the left valve and the proportions of the shells make them recognizable as *O. montis-caprilis*. Distinction between the examined specimens of *Enantiostreon difforme* and of *O. montis-caprilis* accords the characteristic features of these species as given by Frech (1912a).

Dimensions of plesiotypes: maximum length 18 mm

maximum height 20 mm

Distribution: *N. laevigatus*-*M. coxi*-zone, *Ps. fissistriata*-zone, and *Clionites*-bed (Lower Ladinian — Lower Carnian) of Ramon; Middle or Upper Triassic of Transjordan (Cox 1924); Carnian of the Alps, Bakony Forest, Budapest district, and Nevada (S. W. Muller 1936). Allied forms have been recorded from the Triassic beds of Karakorum and Singapore (*O. cf. montis-caprilis*).

Family MYTILIDAE Fleming
Genus *Modiola* Lamarck 1801
Modiola cf. raibliana Bittner 1895
Pl. 3, fig. 3.

Cf. *Modiola raibliana* Bittner 1895, p. 48, pl. 5, fig. 21.

Material: three specimens (HU 20436–20438).

As compared with the original Bittner's description of *M. raibliana*, the specimens from Ramon are characterized by a somewhat shallower embayment of the ventral margin and by a larger angle between the anterior and the posterior parts of the dorsal margin.

Dimensions: length ca. 23 mm
height ca. 10 mm

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon. *M. raibliana* has been recorded from the "lumachelle series" of Araif-el-Naga (Awad 1946); Middle Triassic of Tunisia (Castany *et al.* 1951); Carnian of Tripolitania (Parona 1914*, *fide* Lipparini 1940, p. 230); Carnian of the Alps. A related form, *M. cf. raibliana*, occurs in the Triassic of Tonkin.

Modiola cf. salzstettensis Hohenstein 1913
Pl. 3, fig. 4.

Cf. *Modiola salzstettensis* Hohenstein 1913, p. 55, pl. 1, figs. 16–32.

Material: five specimens (HU 20439–20440; M 3422, 3408/1, 3421).

Although the proportions and the contour of the shells of this species are similar to those of *M. salzstettensis* Hohenstein (op. cit., particularly to figs. 21, 23, 24 of his), the present specimens are considerably larger. Their length varies from 14 to 24 mm, while the length of the specimens from Schwarzwald ranges 5–16 mm.

M. cf. salzstettensis from Ramon is also comparable with *M. minutasformis* Schmidt (1936, p. 78, pl. 5, figs. 12, 13) from the Middle Ladinian of Spain, but its dorsal margin is less convex and its posterior part narrower than those of the Spanish form.

Dimensions: length 14 20 20 24 mm
height 6.5 10 9 11 mm

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon. *M.*

salzstettensis has been recorded by Hohenstein (1913) from the Middle Muschelkalk of Schwarzwald, and a form designated as *M. cf. salzstettensis* is mentioned Schmidt by (1936, p. 68) to occur in the Middle Ladinian (= Upper Muschelkalk) of Spain.

Family MYALINIDAE Frech

Genus *Myalina* de Koninck 1842

*Myalina benecke*i Brotzen 1957

Pl. 3, figs. 10, 11.

*Myalina benecke*i Brotzen 1957, p. 209, pl. 1, fig. 2.

Brotzen has noted (*op. cit.*, p. 197) that the material in his possession did not allow the final generic determination to this species to be made. Of the disarticulated valves collected by the present author, four reveal an edentulous hinge and a ligamental area grooved parallel with the hinge margin. This structure of the hinge is characteristic of *Myalina*.

Dimensions of topotypes: maximum length 50 mm
maximum height 75 mm
apical angle *ca.* 80°

Distribution: *Beneckeia*-zone (Anisian) of Ramon.

Myalina ramanensis Brotzen 1957

Pl. 3, fig. 13.

Myalina ramanensis Brotzen 1957, p. 209, pl. 1, fig. 1, pl. 2, fig. 1.

Dimensions of topotypes: maximum length 55 mm
maximum height 150 mm
inflation (both valves) 50 mm
apical angle *ca.* 80°–70°

Distribution: Ramon, *M. ramanensis*-bank. This bank occurs 18 m above the top of *Beneckeia*-zone and probably is still of Anisian age (*cf.* p. 4).

Family CASSIANELLIDAE Ichikawa 1958

Genus *Cassianella* Beyrich 1862

Cassianella decussata (Münster in Goldfuss 1840)

Pl. 3, figs. 5–7.

Avicula decussata Münster; Goldfuss 1840, p. 128, pl. 116, fig. 12.

Cassianella decussata (Münster); Parona 1889, p. 95, pl. 8, fig. 5.

Cassianella decussata (Münster); Bittner 1895, p. 63, pl. 7, figs. 6–15, 20.

Cassianella decussata (Münster); Arthaber 1906, pl. 39, fig. 4.

Cassianella decussata (Münster); Ogilvie-Gordon 1927, p. 84, pl. 11, fig. 2.

Material: about ten left valves partly embedded in limestone matrix (HU 20416, 20538, 20539).

These valves of *Cassianella* are quite similar to those of *C. decussata* as described and figured by the authors cited above.

Dimensions of plesiotypes: maximum height 9 mm
maximum length near the ventral margin 5–6 mm
number of primary ribs 5–7

Distribution: *Avicula aspera*-bed (Lower to Middle Carnian) of Ramon; Carnian of Spain, Sicily, Apennines, Alps; Middle Triassic of Persia (Douglas 1929*, *vide* Kutassy 1931); Upper Triassic of Yun-Nan, Southern China.

Cassianella cf. *decussata* (Münster in Goldfuss 1840)
Pl. 3, figs. 8, 9.

Material: three left valves (HU 20441, 20442).

The specimens herein referred to as *C. cf. decussata* have the valves more arcuate and rounded than those of previously mentioned *C. decussata*, as well as somewhat less clearly pronounced arrangement of the alternating primary and secondary ribs. These specimens are close to *C. cf. decussata* from the Middle Ladinian of Spain (Schmidt 1936, p. 49, Text-fig. 11). The upper parts of the valves from Ramon are considerably narrower than the dorsal part of a specimen of *C. cf. decussata* from the Lower Muschelkalk of Upper Silesia (Ahlburg 1906, p. 61, pl. 2, figs 5); their dimensions are smaller and the ornamentation finer than those of *Cassianella* sp. nov. Krumbeck aff. *decussatae* (Münster) from the Upper Triassic of Timor (Krumbeck 1924, p. 107, pl. 86, figs. 13, 14.)

Dimensions: height 8 mm, length near the ventral margin 5 mm.

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon; Middle Ladinian of Spain (Schmidt 1936).

Family AVICULIDAE Lamarck
Genus *Avicula* Bruguière 1792
Avicula aspera Pichler 1857
Pl. 3, fig. 12.

Avicula aspera Pichler 1857*, p. 694, fig. 2.

Avicula aspera Pichler; Arthaber 1906, pl. 42, fig. 7.

Avicula aspera Pichler; Bittner 1912, p. 23, pl. 4, figs. 2–5.

Material: one left valve (HU 20455).

A left valve of *Avicula* characteristically ornamented by about 14 wavy, sinusoidal concentric ribs which extend from the margin of the anterior auricle to the margin of the posterior one, agrees well with the description and the figures of *A. aspera* Pichler given by Bittner and Arthaber (*opp. cit.*). The length of the posterior auricle seems to be variable in this species, as evidenced by the specimens from the Bakony Forest, whose posterior auricles are somewhat shorter (Bittner *op. cit.*) than those of the specimens from Northern Tirol (Arthaber *op. cit.*) and Ramon. The extension

of the sinusoidal ribs over the posterior auricle in a direction parallel to the hinge margin, and a pronounced sinusosity below this auricle make *A. aspera* distinguishable from *A. crispata* Goldfuss of the Upper Muschelkalk of Germany (Schmidt 1928, p. 144, fig. 294).

Dimensions of plesiotype: length 14 mm
height 11 mm

Distribution: Lower to Middle Carnian of Ramon (*A. aspera*-bed, unit T₅); Carnian of the Alps, Bakony Forest, Apennines, Sicily.

Family BAKEVELLIIDAE King
Genus *Gervillia* Defrance 1820
Gervillia joleaudi Schmidt 1936
Pl. 3, figs. 14, 15.

Gervillia (*seu Hoernesia*) sp. Joleaud 1912, p. 77, pl. 1.

Gervillia joleaudi Schmidt 1936 p. 53, pl. 4, figs. 17, 18, 20.

Material: twelve specimens represented by fragmentary, disarticulated, and closed valves, and internal moulds (HU 20443/1-3, 20444-20447; M 3411/2, 3412/2, 3414/2, 3415).

The shells belonging to this species are very oblique: an angle of approximately 25° is formed between the dorsal margin and the long axis of the shell. The post-apical part of the shell is slightly more inflated than the prae-apical part, or, in other words, the posterior portion is deeper when observed from within. The hinge consists of a ligament and of fine dental ridges subjacent to the ligamental area. Four closely spaced ligamental notches are present on the ligamental area immediately below the umbons. Additional, more widely spaced notches are situated anteriorly and posteriorly of the latter four. The dental ridges are inclined to the ligamental area thus forming acute angles whose apices point forward. In the region below the umbons these dental ridges shorten and the angles between them and the ligamental area become larger. The ornamentation of the shells consists of fine concentric growth lines.

In one of the specimens of *G. joleaudi* figured by Schmidt (*op. cit.*, fig. 20) an elongated depression is observable on the ligamental area beneath the umbons. In some of the weathered specimens of *G. joleaudi* from Ramon the boundaries between the four closely spaced ligamental notches became obliterated, and, consequently, one elongated depression, similar to that figured by Schmidt (*loc. cit.*), appears.

Dimensions of plesiotypes: maximum length 115 mm
maximum height 35 mm

The umbons subdivide the entire length of a shell in a 1:5 — 1:6 ratio.

Distribution: *Beneckeia*-zone (Anisian) and *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon; Middle Triassic of Algeria (Joleaud 1912; Glangeaud 1952); Middle Ladinian of Spain (Schmidt 1936).

Gervillia aff. *albertii* (Goldfuss 1840)

Pl. 3, fig. 16.

aff. *Avicula albertii* Goldfuss 1840, p. 127, pl. 116, fig. 9.aff. *Gervillia albertii* (Goldfuss); Frech 1912a, p. 13, pl. 1, fig. 8.aff. *Gervillia albertii* (Goldfuss); Schmidt 1928, p. 150, fig. 311.*Material*: a fragment of a right valve (HU 20448).

The structure of the hinge of this valve closely resembles that of *G. albertii*. Four subquadrate notches are situated on the ligamental area (their full number is unknown due to only partial preservation of the hinge). Subjacent to the ligamental area eleven dental ridges are observable. The ridges in the posterior of the area are short, and behind the fourth ligamental notch it is difficult to detect them at all.

The ligamental notches of the present specimen are not as high as those of one figured by Frech (*op. cit.*). As compared with *G. joleaudi* Schmidt, the specimen described here may be distinguished through its higher ligamental area and more widely spaced ligamental notches.

Dimensions: length 60 mm

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon. *G. albertii* occurs in the Lower Muschelkalk of Germany, and in the Anisian beds of the Southern Alps and Dalmatia.

Gervillia cf. *bouéi* (Hauer 1857)

Pl. 4, figs. 1, 2.

Cf. *Perna bouéi* Hauer 1857, p. 565, pl. 5, figs. 1-3.Cf. *Gervillia bouéi* (Hauer); Arthaber 1906, pl. 41, fig. 2.Cf. *Gervillia bouéi* (Hauer); Bittner 1912, p. 30, pl. 5, figs. 7, 8.Cf. *Gervillia bouéi* (Hauer); Cox 1932, p. 105, pl. 7, fig. 14.*Material*: eleven specimens (HU 20499-20451, 20490; M 3/4/08/4, 3426/5).

These specimens seems to be closer to *G. bouéi* than to any other known Triassic species of *Gervillia*. The left valves of these shells are slightly more inflated than the right ones. Although the ligamental notches characteristic of the hinge of *Gervillia* can be seen on two weathered specimens, nevertheless the exact structure of the hinge remains unidentifiable. The obliquity of the examined specimens is of a degree intermediate between that of *G. bouéi* from the Wadi Hesban (Cox *op. cit.*) and that of the specimens from the Bakony Forest (Bittner *op. cit.*). The contours of the shells of *G. cf. bouéi* are also comparable with those of *G. sancti-galli* Stoppani from the Carnian of Lombardy (Parona 1889, p. 97, pl. 6, figs. 4, 5), but the growth lines of the present specimens are finer and their valves less inflated. As compared with *G. benetti* Boehm (1903, p. 36, pl. 4, figs. 13, 17), the discussed specimens differ in their smaller anterior wings and more strongly prosogyrous umbons. However,

Cox (1932, p. 105) noted that *G. benetti* Boehm might be synonymous with *G. bouéi* (Hauer).

Dimensions: length 25–31 mm
height 21–28 mm
inflation (left valve) 6–10 mm

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon and Araif-el-Naga. *G. bouéi* has been recorded from the Carnian of the Alps, Bakony Forest and Sumatra (Krijnen 1931).

Family LIMIDAE d'Orbigny
Genus *Lima* Bruguière 1792
Lima striata (Schlotheim 1823)
Pl. 4, figs. 3, 4.

Chamites striatus Schlotheim 1823*, pl. 34, fig. 1.

Lima striata (Schlotheim); Goldfuss 1840 p. 78, pl. 100, fig. 1.

Lima striata (Schlotheim); Philippi 1905 pl. 4, fig. 7.

Cf. *Lima striata* Goldfuss typus; Assmann 1937, p. 49, pl. 10, fig. 14.

Material: ten specimens (HU 20456, 20457; M 3413/1, 3420, 3423).

Specimens of *Lima* ornamented by 25–30 rounded radial ribs belong to this species. The intercostal grooves are as wide as the ribs. In this detail of ornamentation the examined specimens differ from the specimens of *L. striata* recorded by Assmann (*op. cit.*) from the Muschelkalk of Upper Silesia: the ribs and the interspaces of the Upper Silesian form are wider and narrower, respectively, than those of the shells from Ramon. *L. striata* seems to be related morphologically to *L. tarammelii* Tommasi (1904, p. 301, pl. 8) from the Anisian of Recoaro, but the ornamentation of the North Italian species is more complicated due to the presence of three-four thin secondary ribs which run along each of the intercostal grooves.

Dimensions of plesiotypes: maximum length 40 mm
maximum height 55 mm

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon; Röt to Keuper of Germany; Röt dolomit to Upper Muschelkalk of Upper Silesia (Assmann 1937); Muschelkalk of Swietz Krzycz Mts. (Senkowiczowa 1956–7–8); Anisian of the Southern Alps; Muschelkalk of Sardinia; Upper Anisian of Plouk, Cambodia (Saurin 1935).

L. striata is mentioned by Wagner (1934) as occurring in the Triassic deposits of the Dead Sea valley, and specimens referable to *L. striata* have been recorded by Cox (1924, p. 72) from the Wadi Hesban locality.

Fragmentary shells of *Lima* sp. ind. ornamented somewhat similarly to *L. striata* were recorded by Parona (1928) from the Triassic of Karakorum.

Lima cf. *telleri* Bittner 1895

Pl. 4, fig. 5, 6.

Cf. *Lima telleri* Bittner 1895, p. 194, pl. 24, fig. 4.Cf. *Lima telleri* Bittner; Philippi 1904, p. 28, pl. 6, fig. 22.Cf. *Lima* cf. *telleri* Bittner; Schmidt 1936, p. 57, pl. 4, fig. 21.**Material:** ten specimens (HU 20458/1-7).

The shape of the shells of *L. cf. telleri* is slightly less oblique than that of a specimen figured by Bittner (*op. cit.*), but the ornamentation consisting of 28-35 thin radial ribs, rounded in cross-section, is quite similar in both cases. The length/height ratio of the specimens from Ramon is somewhat smaller than that of a specimen recorded by Schmidt (*op. cit.*) from the Anisian (?) of Spain.

Dimensions: length 11-16 mm

height 11-15 mm

angle between marginal ribs 83°-92°.

Distribution: *Ps. fissistriata*-zone (Middle to Upper Ladinian) of Ramon. The Spanish form, *L. cf. telleri*, occurs in the Anisian (?), and *L. telleri* is distributed in the strata of Ladinian age in the Southern Alps.

Genus *Mysidioptera* Salomon 1895*Mysidioptera* cf. *vix-costata* (Stoppani 1860)

Pl. 4, fig. 8.

Cf. *Lima vix-costata* Stoppani 1860*, p. 97, pl. 19, fig. 16.Cf. *Mysidioptera vix-costata* (Stoppani); Bittner 1895, p. 189, pl. 20, figs. 24-26.Cf. *Mysidioptera* cf. *vix-costata* (Stoppani); Cox 1924, p. 72, pl. 2, fig. 2.Cf. *Mysidioptera vix-costata* (Stoppani); Renz 1940, p. 71, pl. 14, fig. 6.**Material:** one left valve (HU 20459).

The valve is elliptical-trapezoidal in contour. The upper part of the anterior margin is concave; its lower part is gently convex and passes gradually into a fairly rounded ventral margin. The hinge margin is straight. A prosogyrous umbo is situated at its anterior extremity. The surface of the valve is ornamented by several imbricating growth lamellae. The anterior portion of the valve dipping steeply toward the anterior margin is additionally ornamented by fine radial ribs.

The concavity of the anterior margin of this specimen is somewhat longer than that of a specimen from Transjordan (Cox, *op. cit.*), and its ornamentation is more simple than one of a specimen from Karakorum (Renz, *op. cit.*).

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon. *M. vix-costata*, as well as the forms mentioned above, occur in the Ladinian of the Southern Alps, Middle or Upper Triassic of Transjordan, and in the Triassic deposits of Karakorum.

Mysidioptera cf. *gremblighii* Bittner 1895

Pl. 4, fig. 7

Cf. *Mysidioptera gremblighii* Bittner 1895, p. 191, pl. 22, fig. 14.Cf. *Mysidioptera gremblighii* Bittner; Bittner 1912, p. 66, pl. 2, figs. 10, 11, 13, 14.*Material*: one right valve with slightly corroded margins (HU 20460).

A rounded-trapezoidal shell of *Mysidioptera* ornamented by numerous fine striae radiating from the umbo resembles in its contour and ornamentation a Carnian *Mysidioptera gremblighii*. However, the convexity of the ventral part of the anterior margin is less pronounced here than in Bittner's figures.

Dimensions: length 40 mm

height 45 mm

inflation 12 mm

Distribution: *Avicula aspera*-bed (Lower to Middle Carnian) of Ramon. *M. gremblighii* occurs in the Carnian of the Alps and Bakony Forest.

Family PECTINIDAE Lamarck

Genus *Pecten* Müller 1776*Pecten discites* (Schlotheim 1820)

Pl. 4, figs. 9, 10.

Pleuronectites discites Schlotheim 1820*, p. 218.*Pecten discites* (Schlotheim); Goldfuss 1840, p. 73, pl. 98, fig. 10.*Pecten filusus* Hauer; Parona 1889, p. 87, pl. 6, figs. 1-5.*Pecten discites* (Schlotheim); Salomon 1895, pp. 109, 145, pl. 4, figs. 20-26.*Pecten discites* (Schlotheim); Philippi 1905, pl. 4, fig. 9.*Pecten discites* (Schlotheim); Bittner 1912, p. 97, pl. 8, fig. 25.*Pecten hellii* Emmerich; Bittner 1912, p. 105, pl. 8, figs. 36, 37.*Pecten discites* (Schlotheim); Schmidt 1928, p. 157, fig. 336.*Pecten discites* (Schlotheim); Awad 1946, p. 59, pl. 4, fig. 27.

Material: about fifteen specimens (HU 20461-20466, 20487, 20489, 20536; M 3409, 3404/5, 3405, 3408/3, 3412, 3418, 3431).

On the surface of the weathered shells of this species characteristic radial dichotomous fibres are observable. The internal layer of the shell bears two lateral divergent ridges whose impressions are sometimes preserved on the internal moulds. These internal ribs are either smooth, or small nodular swellings may be present at their ventral extremities.

P. hellii Emmerich from the Rhaetian of the Alps was referred to by Parona (*op. cit.*) as a synonym of *P. filusus* Hauer, while the latter species has been considered by Cox (1924, p. 70) as being identical with *P. discites* (Schlotheim). Actually, two internal ribs similar to those of *P. discites* are revealed by some of the specimens of *P. filusus* figured by Parona (*op. cit.*). The interior of the valves with the internal layer eroded reveals only the fibrous structure of the middle layer (cf. Parona, *op. cit.*, fig. 4). A

specimen of *P. discites* in the same state of weathering has also been collected from the *Avicula aspera*-bed in Ramon.

Dimensions of plesiotypes: length 18–40 mm; the length/height ratio is close to 1:1.

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon and Araif-el-Naga; *Ps. fissistriata*-zone (Middle to Upper Ladinian) and *Avicula aspera*-bed (Lower to Middle Carnian) of Ramon.

The entire stratigraphic range of this species is from Werfenian to Norian and it occurs in the Ussuri province, Eastern Cambodia (Saurin 1935), Salt Range, Transjordan (Cox 1924), Tunisia (Castany *et al.* 1951), Spain (Schmidt 1936), Northern Italy, Southern Alps, Bihor Mts., Bakony Forest, Villany and Budapest districts, Dobrudja, Germany, Upper Silesia (Assmann 1937), Swiety Krzycz Mts. (Senkowiczowa 1956–7–8), and in the State of Nequem, Argentine (Groeber 1924*, *fide* Kummel and Fuchs 1953).

Pecten (Pleuronectites) cf. laevigatus (Schlotheim 1820)

Pl. 4, figs. 11, 12.

Cf. *Pleuronectites laevigatus* Schlotheim 1820*, p. 217.

Cf. *Pecten vestitus* Goldfuss 1840, p. 72, pl. 98, fig. 9.

Cf. *Pecten laevigatus* (Schlotheim); Philippi 1900, p. 78, fig. 1.

Cf. *Pleuronectites laevigatus* (Schlotheim); Salomon 1900, p. 348, pl. 14, figs. 1, 2.

Cf. *Pecten laevigatus* (Schlotheim); Philippi 1905, pl. 4, fig. 10.

Cf. *Pleuronectites laevigatus* Schlotheim; Frech 1912a, p. 15, fig. 5.

Cf. *Pecten (Pleuronectites) laevigatus* (Schlotheim); Schmidt 1928, p. 158, fig. 338.

Material: four right valves and one specimen with both valves closed, their upper portion corroded (HU 20467, 20468; M 3407/1, 3413/3).

The right valve of *P. laevigatus* is characterized by several "teeth" situated along the ventral margin of the byssal sinus and projecting into it. No such structures are observable in the present specimens due, probably, to insufficient preservation. The lack of this structure prevents the specimens from Ramon from being identified strictly as *P. laevigatus*, but in other respects they resemble *P. laevigatus* very closely. These specimens are distinguishable from *P. schmiederi* Giebel (Schmidt 1928, p. 159, fig. 239) by their more acute byssal embayments, more elliptical than circular contour, and a lack of fine radial striae which ornament the valves of *P. schmiederi*.

Those species of the Triassic Pectinidae which possess well developed byssal embayments have been referred to by Philippi (1899) as derived from the Palaeozoic types.

Dimensions: length 40–50 mm

height 45–55 mm

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon. *P. laevigatus* occurs in beds of Muschelkalk and Keuper age in Germany; Lower and Middle Muschelkalk of Upper Silesia (Assmann 1937); Muschelkalk of Swiety Krzycz Mts.

(Senkowiczowa 1956-57); Upper Muschelkalk of the Kanton Aargau (Herb 1957).

Pecten albertii (Goldfuss 1840)

Pl. 4, fig. 14.

Monotis albertii Goldfuss 1840, p. 138, pl. 120, fig. 6.

Pecten inaequistriatus Münster; Goldfuss 1840, p. 42, pl. 89, fig. 1.

Pecten albertii (Goldfuss); Philippi 1905, pl. 4, fig. 8.

Pecten inaequistriatus Münster; Cox 1924, p. 68, pl. 1, fig. 16.

Velopecten albertii (Goldfuss); Schmidt 1936, p. 61, pl. 4, figs. 30, 31.

Pecten inaequistriatus Münster; Awad 1946, p. 421, pl. 2, fig. 13.

Material: two specimens (HU 20469).

Small pectiniform shells ornamented by two sets of alternating fine primary and secondary ribs are referable to this species. Provided that Diener's (1923, p. 65) inclusion of *P. inaequistriatus* under *P. albertii* is accepted, the number of ornamenting ribs becomes rather variable in this species.

Dimensions of plesiotypes: length 12-13 mm

height 12-13 mm

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon; lower part of the "lumachelle series" of Araif-el-Naga (Awad 1946; this might be of an early Ladinian or of Anisian age — *A. L.*); Middle or Upper Triassic of the Wadi Hesban (Cox 1924); Röt to Grenzdolomit of Germany; Rötdolomit to Lower Muschelkalk, and the Lower Keuper beds of Upper Silesia (Assmann 1937); Buntsandstein to Upper Muschelkalk of Swiety Krzys Mts. (Senkowiczowa 1956-7); Werfenian of the Ussuri province, Mt. Bogdo, Salt Range, Dobrudja, Bakony Forest; Werfenian to Ladinian of the Southern Alps; Carnian of the Northern Alps; Middle Ladinian of Spain (Schmidt 1936).

Pecten aff. *subalternans* d'Orbigny 1850

Pl. 4, fig. 15.

aff. *Pecten alternans* Münster; Goldfuss 1840, p. 12, pl. 88, fig. 11.

aff. *Pecten subalternans* d'Orbigny 1850, p. 202.

aff. *Pecten subalternans* d'Orbigny; Bittner 1895, p. 154, pl. 18, fig. 25.

aff. *Pecten subalternans* d'Orbigny; Diener 1923, p. 66.

Material: two fragmentary valves (HU 20470).

The ornamentation of these valves consists of alternating primary and secondary smooth ribs, and is, therefore, more similar to the ornamentation of the specimen figured by Goldfuss (*op.cit.*) than to the ornamentation of the St. Cassian specimens (Bittner, *op. cit.*) whose ribs are tuberculate. The pattern of the ornamentation of the specimens from Ramon resembles closely that of *Pecten* nov. sp. ind. Diener aff. *subalternans* d'Orbigny from the Carnian of the Himalaya (Diener 1909, p. 31, pl. 5, fig. 16), but any further comparison between the Himalayan and the Ramon material

becomes difficult owing to the corrosion of the auricles and the margins of the examined valves.

Dimensions: 13 × 13 mm; 6.5 × 6.5 mm.

Distribution: *Avicula aspera*-bed (Lower to Middle Carnian) of Ramon. Except for the species described by Diener (1909) from the Carnian of the Himalaya *P. subalternans* has been recorded only from the Carnian beds of the Southern Alps and Northern Italy.

Pecten sp.

Pl. 4, fig. 13.

Only one right valve of this species is present (HU 20471/1). It is ornamented by extremely fine concentric growth lines which are observable on a part of the surface. The hinge line is straight and its prolongation forms an angle of less than 90° with the prolongation of the posterior margin of the posterior auricle. The apex of this auricle is slightly arcuate.

The present valve is somewhat similar in its outline to *P. balatonicus* Bittner (1912, p. 43, pl. 5, figs. 9–11) from the Carnian of the Bakony Forest, but the shape of the posterior auricle of Bittner's species is different, since an obtuse angle is formed near the apex of this auricle. As compared with *Pecten* sp. nov. Krumbeck aff. *balatonicus* Bittner from the Triassic of Timor (Krumbeck 1924, p. 340, pl. 198, fig. 5), the umbo of the specimen from Ramon is more orthogyrous, and the shape of the posterior auricle of the Timorian species is closer to that of *P. balatonicus* than to that of *Pecten* sp. from Ramon.

Dimensions: length 9 mm, height 10 mm

length of anterior auricle 3.8 mm

length of posterior auricle 3 mm

Distribution: *Avicula aspera*-bed (Lower to Middle Carnian) of Ramon.

Family LUCINIDAE Fleming

Genus *Schafhäutlia* Cossmann 1897

Schafhäutlia aff. *mellingi* (Hauer 1857)

Pl. 5, figs. 1–4.

? *Corbis mellingi* Hauer 1857, p. 549, pl. 3, figs. 1–5.

aff. *Fimbria* (*Sphaeriola*) *mellingi* (Hauer); Parona 1889, p. 140, pl. 8, figs. 3, 4.

aff. *Gonodon planum* (Münster); Salomon 1895, p. 169, pl. 5, fig. 47a.

aff. *Schafhäutlia mellingi* (Hauer); Waagen 1907, p. 84, pl. 33, figs. 20, 21.

aff. *Gonodon mellingi* (Hauer); Bittner 1912, p. 7, pl. 7, figs. 9–11.

? *Gonodus mellingi* (Hauer); Frech 1912a, p. 58, pl. 8, fig. 10.

aff. *Schafhäutlia mellingi* (Hauer); Bubnoff 1921, pp. 326–329.

aff. *Gonodon* (*Corbis*) *mellingi* (Hauer); Ogilvie-Gordon 1927, p. 88, pl. 12, fig. 1.

Material: eight specimens with exposed hinge structure; numerous others occur embedded partly in limestone matrix (HU 20472–20477, 20491, 20493; M 3410, 3426/7–8, 3427).

Sphaeroidal, inflated shells with strongly prosogyrous umbons, variably deep lunulas, and the ornamentation consisting of concentric growth lines, resemble the specimens described by the above cited authors as belonging to *S. mellingi*. Some of the specimens collected in Ramon are longer than high and thus agree better with *S. mellingi* var. *balatonica* Frech (*op. cit.*). The dentition of the right valves of the examined specimens consists of two short cardinal teeth diverging from beneath the umbo. If corroded, the boundaries between these teeth may become indistinct, and consequently, one hoof-shaped structure similar to that of *Schafhäutlia* sp. (Frech 1912a, p. 57, pl. 8, fig. 11 — "*Gonodus* sp.") appears. The left valve carries one elongated triangular cardinal tooth which may or may not reach dorsally the hinge margin. This structure of the hinge is in accordance with a scheme given by Parona, Waagen, and Bittner (*op. cit.*). On the other hand, the dentition of the right valves of the specimens figured by Hauer and Frech (*op. cit.*) is different: it consists of two divergent cardinal teeth and of an additional elongated lateral tooth.

The specimens from Ramon and Araif-el-Naga might be possibly related to *Schafhäutlia* sp. nov. Awad (1946, p. 423, pl. 2, fig. 11).

Dimensions: length 6.5–26 mm
height 5.0–25 mm

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon and Araif-el-Naga; *Avicula aspera*-bed (Lower to Middle Carnian) of Ramon. *S. mellingi* (Hauer) has been recorded discontinuously from the strata of Ladinian, Carnian, Norian, and Rhaetian age (Chiesa 1949). Its geographic distribution is also very extensive and it has been reported as occurring in the Southern Alps, Northern Italy, Hungary, Sicily, East Indies, New Zealand, and Japan (Ichikawa 1950*, *vide* Ichikawa 1954, p. 61).

S. mellingi has been identified by Vroman (1946; Eicher 1947) from Araif-el-Naga, but none of the specimens studied by him were available to the present author's examination.

Family ANTHRACOSIIDAE Amalitzky

Genus *Anodontophora* Cossmann 1897

Anodontophora münsteri (Wissmann in Münster 1841)

Pl. 5, figs. 5, 6.

Unionites münsteri Wissmann in Münster 1841*, p. 81, pl. 16, fig. 5.

Anodontophora münsteri (Wissmann); Bittner 1895, p. 9, pl. 1, figs. 22, 23.

Anodontophora münsteri (Wissmann); Cox 1924, p. 75, pl. 2, figs. 7, 8.

Anoplophora münsteri (Wissmann); Ogilvie-Gordon 1927, pl. 11, fig. 7.

Anodontophora münsteri (Wissmann); Saurin 1935, p. 132, pl. 12, fig. 2.

Anodontophora münsteri (Wissmann); Schmidt 1936, p. 73, pl. 5, figs. 20–23.

Anodontophora münsteri (Wissmann); Awad 1946, p. 420.

Material: ten specimens (HU 20478, 20479; M 3406/1, 3408/2, 3426/6).

The specimens of *A. münsteri* from Ramon and Araif-el-Naga are apparently

identical with those described and figured by Bittner, Ogilvie-Gordon, Schmidt, and Awad (*op. cit.*). However, they are slightly more inflated and their lunulas are deeper than those of the specimens recorded by Cox (*op. cit.*) from Transjordan. The average of the shells discussed here is more elongated than one recorded by Saurin (*op. cit.*) from Darlac.

Dimensions of plesiotypes: maximum length 27 mm
maximum height 11 mm

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon and Araif-el-Naga; Muschelkalk and Lettenkohle of Germany; Carnian of the Southern Alps; Middle Ladinian to Keuper of Spain (Schmidt 1936); Middle Triassic of Tunisia (Castany *et al.* 1951); Middle or Upper Triassic of Transjordan (Cox 1924); the base of Norian in Darlac and Western Tonkin, and Upper Anisian of Eastern Cambodia (Saurin 1935).

Cf. *Anodontophora fassaensis* (Wissmann in Münster 1841)

Pl. 5, fig. 7.

Cf. *Myacites fassaensis* Wissmann in Münster 1841*, p. 9, pl. 16, fig. 2.

Cf. *Myacites fassaensis* Wissmann var. *brevis* Bittner 1912, p. 84, pl. 9, figs. 13-17.

Cf. *Homomya fassaensis* (Wissmann); Leonardi 1935, p. 32, pl. 1, figs. 5, 6.

Material: two internal moulds (M 3428).

As little as can be said on the generic position of these specimens, they resemble those of *A. fassaensis* figured by Bittner and Leonardi (*opp. cit.*). They differ, however, from the specimens of *A. fassaensis* recorded by Cox (1932, p. 98, pl. 7, fig. 6) from the Werfenian beds of the Wadi Zerka-Main in being more prosogyrous and considerably shorter due to truncation of the posterior portion of the shell.

Dimensions: length 15 17 mm
height 13 14 mm

Distribution: the present specimens were found in a thin layer of reddish-brown limestone, approximately 20-25 metres below the equivalent of *Beneckeia*-zone in Araif-el-Naga. *A. fassaensis* ranges from Röt to Lettenkohle of Germany; Rötdolomit to Lower Muschelkalk of Upper Silesia; (Assmann 1937); Werfenian of the Southern and Venetian Alps (Leonardi 1935), Western Balkans (Bešić 1950), Bakony Forest, Spitzbergen, Bukhara and Ussuri provinces of Russia, Wadi Zerka-Main (Cox 1932) and Idaho, USA (Kummel 1954).

A form identified by L. Picard (in Shaw 1947, p. 17) as aff. *Homomya* (*Anoplophora*) *fassaensis* (Wissmann) has been recorded from the Triassic of Ramon. This material has not been seen by the present author.

Family PLEUROMYIDAE Zittel
Genus *Pleuromya* Agassiz 1842
Pleuromya cf. *mactroides* (Schlotheim 1820)
Pl. 5, figs. 8, 9.

Cf. *Myacites mactroides* Schlotheim 1820*, p. 178.

Cf. *Pleuromya mactroides* (Schlotheim); Bender 1921, p. 95, pl. 4, figs. 2, 3.

Cf. *Pleuromya mactroides* (Schlotheim); Schmidt 1928, p. 204, fig. 494.

Material: three internal moulds and one right valve, corroded (HU 20480/1-3; M 3404/6, 3416).

According to Bender (*op. cit.*), the distinction between *P. mactroides* and *P. musculoides* is to be based on the values of the length/height/inflation ratios. (L, H and D, respectively).

The specimens collected in Ramon have been measured as follows:

L	35	32	—	28	mm
H	18	18	17	16	mm
D	14	—	13	—	mm
L:H	1.94	1.78	—	1.75	
L:D	2.50	—	—	—	
H:D	1.29	—	1.31	—	
L:L _A	2.7	3.2	—	2.8	

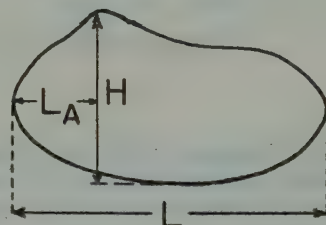


Figure 9

The measured ratios L:H, L:D, H:D are closer to the respective ratios of *P. mactroides* than to the ratios obtained from the shells of other species of *Pleuromya*, as given by Bender (*op. cit.*).

Distribution: *N. laevigatus*-*M. coxi*-zone (Lower Ladinian) of Ramon. *P. mactroides* ranges from Röt to Keuper of Germany; it has been recorded also from the Lower Muschelkalk of Spain (Virgili 1955, p. 45); Anisian of the Southern Alps and Nevada (S. W. Muller and Ferguson 1939).

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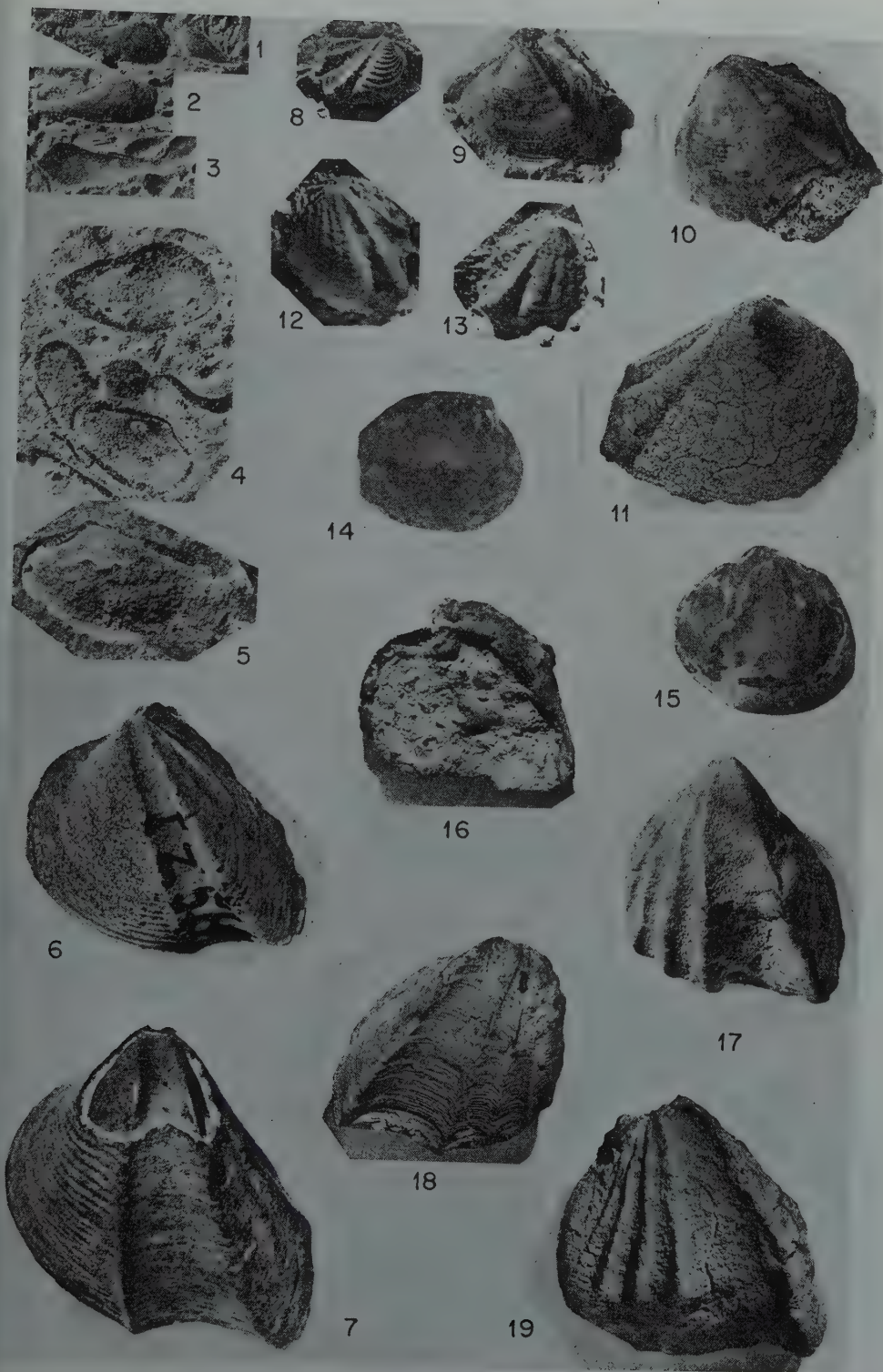
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EXPLANATION OF PLATE 1

- Figure 1. *Leda cf. fibula* Mansuy. Right valve, x1. Lower Ladinian, Ramon (HU 20407).
- Figure 2. *Leda cf. fibula* Mansuy. Right valve, x1. Lower Ladinian, Ramon (HU 20407).
- Figure 3. *Leda cf. fibula* Mansuy. Left valve, x1. Lower Ladinian, Ramon (HU 20407).
- Figure 4. *Palaeoneilo elliptica* (Goldfuss). Weathered right valves, x2. Lower Ladinian, Ramon (HU 20403).
- Figure 5. *Palaeoneilo elliptica* (Goldfuss). Left valve, internal mould with preserved hinge teeth, x2. Lower Ladinian, Ramon (HU 20402).
- Figure 6. *Myophoria intermedia* Schaubroth. x2. Anisian, Ramon (M 3424).
- Figure 7. *Myophoria vulgaris* (Schlotheim). x2. Anisian, Ramon (HU 20382).
- Figure 8. *Myophoria elegans* (Dunker). x2. Lower Ladinian, Ramon (HU 20405).
- Figure 9. *Myophoria germanica* Hohenstein. x2. Lower Ladinian, Araif-el-Naga (M 3426/1).
- Figure 10. *Myophoria germanica* Hohenstein. x2. Lower Ladinian, Ramon (HU 20408/1).
- Figure 11. *Myophoria germanica* Hohenstein. x2. Lower Ladinian, Ramon (HU 20409).
- Figure 12. *Myophoria woehrmanni* Bittner. Left valve, x2. Lower to Middle Carnian (*Avicula aspera*-bed), Ramon (HU 20412/1).
- Figure 13. *Myophoria woehrmanni* Bittner. Right valve, x2. Lower to Middle Carnian (*Avicula aspera*-bed), Ramon (HU 20418).
- Figure 14. *Neoschizodus orbicularis* (Bronn). Right valve, x2. Anisian, Ramon (M 3403).
- Figure 15. *Neoschizodus orbicularis* (Bronn). Left valve, x2. Anisian, Ramon (HU 20391).
- Figure 16. *Myophoria coxi* Awad. Right valve with exposed cardinal tooth, x1. Lower Ladinian, Ramon (HU 20399).
- Figure 17. *Myophoria coxi* Awad. x2. Lower Ladinian, Ramon (HU 20400)..
- Figure 18. *Myophoria coxi* Awad. x1. Lower Ladinian, Araif-el-Naga (HU 20534).
- Figure 19. *Myophoria coxi* Awad. x1. Lower Ladinian, Ramon (HU 20398).



EXPLANATION OF PLATE 2

- Figure 1. *Myophoria multicostata* sp. nov. Left valve, areal view, x2. An acute rib subdivides the area into two parts. The inner part is ornamented by four fine ribs. Lower Ladinian, Ramon (HU 20419/48).
- Figure 2. *Myophoria multicostata* sp. nov. Left valve, x1. Lower Ladinian, Ramon (Holotype, HU 20419/51).
- Figure 3. *Myophoria multicostata* sp. nov. Left valve with two secondary ribs present in the main furrow, x1. Lower Ladinian, Ramon (HU 20419/47).
- Figure 4. *Myophoria multicostata* sp. nov. Left valve with the main furrow smooth, x1. Lower Ladinian, Ramon (HU 20419/50).
- Figure 5. *Myophoria multicostata* sp. nov. Left valve, x1. Lower Ladinian, Ramon (HU20419/48).
- Figure 6. *Myophoria multicostata* sp. nov. Right valve, x1.5. Lower Ladinian, Ramon (Holotype, HU 20419/51).
- Figure 7. ?*Myophoria* sp. Left valve, x2. Carnian (Lower *Spiriferina lipoldi*-bed), Ramon (HU 20486).
- Figure 8. *Myophoria* sp. ind. Left valve, ca. x3. Carnian (Upper *Spiriferina lipoldi*-bed), Ramon (M 3425/1).
- Figure 9. *Myophoria* sp. ind. Right valve, ca. x3. Carnian (Upper *Spiriferina lipoldi*-bed), Ramon (M 3425/2).
- Figure 10. Cf. *Myophoriopsis subundata* (Schauroth). x2. Middle to Upper Ladinian, Ramon (HU 20769/1).
- Figure 11. Cf. *Myophoriopsis subundata* (Schauroth). x2. Middle to Upper Ladinian, Ramon (HU 20769/2).
- Figure 12. Cf. *Myophoriopsis subundata* (Schauroth). x2. Lower Ladinian, Ramon (HU 20422).
- Figure 13. Cf. *Myophoriopsis subundata* (Schauroth). x2. Lower Ladinian, Araif-el-Naga (M 3426/2).
- Figure 14. *Neoschizodus laevigatus* (Ziethen). x1. Lower Ladinian, Araif-el-Naga (M 3426/4).
- Figure 15. *Neoschizodus laevigatus* (Ziethen). x1. Lower Ladinian, Ramon (HU 20390).
- Figure 16. *Placunopsis* cf. *ostracina* (Schlotheim). x2. Lower Ladinian, Ramon (HU 20453).
- Figure 17. *Pseudoplacunopsis fissistriata* (Winkler). x1. 5. Lower Ladinian, Ramon (HU 20425/1).
- Figure 18. *Pseudoplacunopsis fissistriata* (Winkler). x1. 3. Lower Ladinian, Ramon (HU 20425/2).
- Figure 19. *Trigonodus tenuidentatus* sp. nov. Left valve, x1. Anisian, Ramon (Holotype, HU 20423/1).
- Figure 20. *Trigonodus tenuidentatus* sp. nov. Right valve, x1. Anisian, Ramon (HU 20423/2).
- Figure 21. *Trigonodus tenuidentatus* sp. nov. Left valve, x1. Anisian, Ramon (HU 20423/3).
- Figure 22. *Placunopsis* cf. *flabellum* Schmidt. x1. Lower Ladinian, Ramon (HU 20454/1).



PLATE 2

EXPLANATION OF PLATE 3

- Figure 1. *Enantiostreon difforme* (Schlotheim). Right valve, x2. Lower Ladinian, Ramon (HU 20429).
- Figure 2. *Ostrea montis-caprilis* Klipstein. Left valve, x2. Lower Carnian, Ramon (HU 20433).
- Figure 3. *Modiola cf. raibliana* Bittner, Right valve, x2. Lower Ladinian, Ramon (HU 20436).
- Figure 4. *Modiola cf. salztettensis* Hohenstein. Left valve, x1. Lower Ladinian, Ramon (M 3422).
- Figure 5. *Cassianella decussata* (Münster). Left valve, ventral part, x2. Lower to Middle Carnian (*Avicula aspera*-bed), Ramon (HU 20412/2).
- Figure 6. *Cassianella decussata* (Münster). Left valve, apical view, x2. Lower to Middle Carnian (*Avicula aspera*-bed), Ramon (HU 20539).
- Figure 7. *Cassianella decussata* (Münster). Left valve, x2. Lower to Middle Carnian (*Avicula aspera*-bed), Ramon (HU 20538).
- Figure 8. *Cassianella cf. decussata* (Münster). Left valve, x2. Lower Ladinian, Ramon (HU 20442.)
- Figure 9. *Cassianella cf. decussata* (Münster). Left valve, x2. Lower Ladinian, Ramon (HU 20441).
- Figure 10. *Myalina beneckeï* Brotzen. Apical view of the hinge, right valve, x2. Anisian, Ramon (HU 20401/1).
- Figure 11. *Myalina beneckeï* Brotzen. Apical view of the hinge, right valve, x1. Anisian, Ramon (HU 20401/2).
- Figure 12. *Avicula aspera* Pichler. Left valve, x2. Lower to Middle Carnian, Ramon (HU 20455).
- Figure 13. *Myalina ramanensis* Brotzen. Anterior view, x0.5. Anisian, Ramon (HU 20380).
- Figure 14. *Gervillia joleaudi* Schmidt. Left valve with the exposed hinge, x1. Anisian, Ramon (HU 20433/1).
- Figure 15. *Gervillia joleaudi* Schmidt. Left valve, external view, x. 1.14. Anisian, Ramon (HU 20446).
- Figure 16. *Gervillia aff. albertii* (Goldfuss). The hinge of the right valve, x1. Lower Ladinian, Ramon (HU 20448).



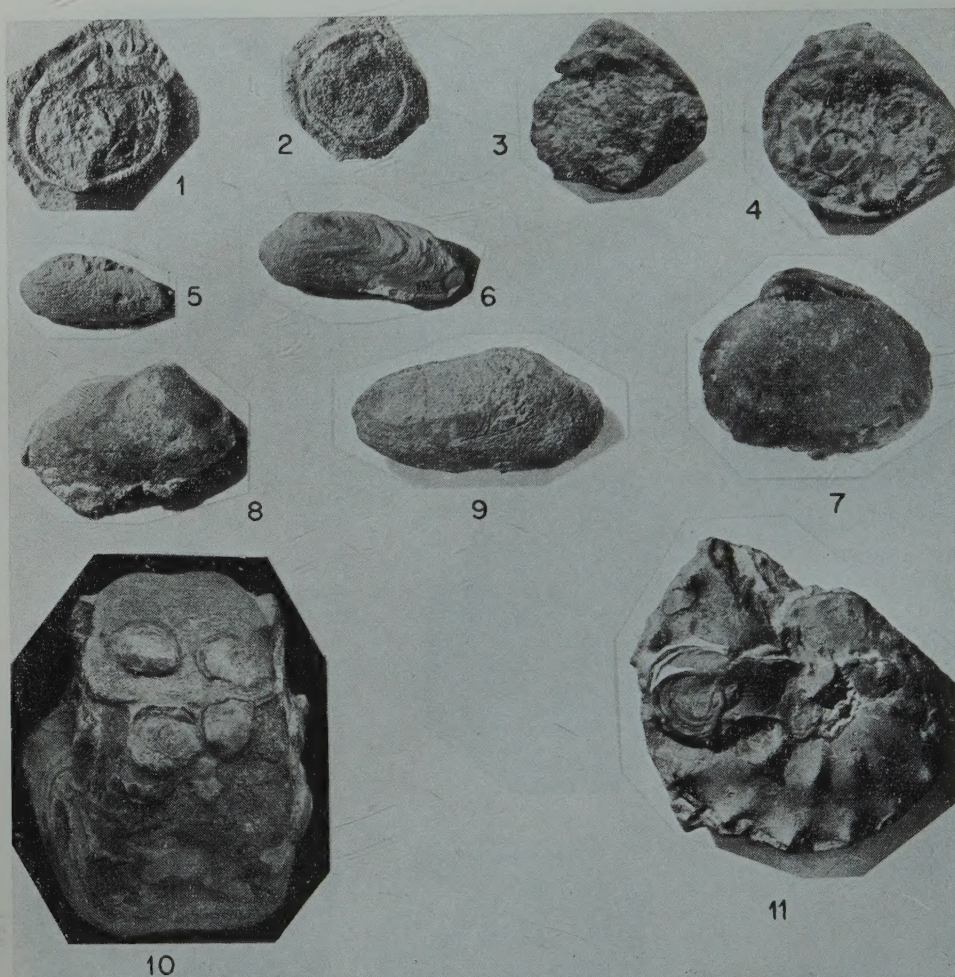
PLATE 3

EXPLANATION OF PLATE 4

- Figure 1. *Gervillia* cf. *bouéi* (Hauer). x1. Lower Ladinian, Araif-el-Naga (M 3426/5).
- Figure 2. *Gervillia* cf. *bouéi* (Hauer). x1. Lower Ladinian, Ramon (HU 20451).
- Figure 3. *Lima striata* (Schlotheim), internal mould, x1. Lower Ladinian, Ramon (HU 20456).
- Figure 4. *Lima striata* (Schlotheim). x0.75. Lower Ladinian, Ramon (M 3420).
- Figure 5. *Lima* cf. *telleri* Bittner. x2. Middle to Upper Ladinian, Ramon (HU 20458/6).
- Figure 6. *Lima* cf. *telleri* Bittner. x2. Middle to Upper Ladinian, Ramon (HU 20458/1).
- Figure 7. *Mysidioptera* cf. *gremblighii* Bittner. x1. Lower to Middle Carnian (*Avicula aspera*-bed), Ramon (HU 20460).
- Figure 8. *Mysidioptera* cf. *vix-costata* (Stoppani). x1. Lower Ladinian, Ramon (HU 20459).
- Figure 9. *Pecten discites* (Schlotheim). Internal view. x1, Lower Ladinian, Ramon (M 3409).
- Figure 10. *Pecten discites* (Schlotheim). External view, x1. Lower Ladinian, Ramon (HU 20464).
- Figure 11. *Pecten* cf. *laevigatus* (Schlotheim). Right valve, x1. Lower Ladinian, Ramon (HU 20773).
- Figure 12. *Pecten* cf. *laevigatus* (Schlotheim). Right valve with the shells of *Placunopsis* or *Pseudoplacunopsis* attached to it, x1. Lower Ladinian, Ramon (HU 20468).
- Figure 13. *Pecten* sp. x2. Lower to Middle Carnian (*Avicula aspera*-bed), Ramon (HU 20471).
- Figure 14. *Pecten albertii* (Goldfuss). x2. Lower Ladinian, Ramon (HU 20469).
- Figure 15. *Pecten* aff. *subalternans* d'Orbigny. x2. Lower to Middle Carnian (*Avicula aspera*-bed) Ramon (HU 20470).



PLATE 4



EXPLANATION OF PLATE 5

- Figure 1. *Schafhäutlia* aff. *mellingi* (Hauer). Exposed hinge of the left valve, x1. Lower Ladinian, Ramon (HU 20472/1).
- Figure 2. *Schafhäutlia* aff. *mellingi* (Hauer). Exposed hinge of the left valve, x1. Lower Ladinian, Ramon (HU 20472/2).
- Figure 3. *Schafhäutlia* aff. *mellingi* (Hauer). Right valve, x1. Two divergent cardinal teeth are seen below the umbo. Lower Ladinian, Ramon (HU 20473).
- Figure 4. *Schafhäutlia* aff. *mellingi* (Hauer). Right valve, x1. Due to corrosion one hoof-shaped cardinal structure is seen. Lower Ladinian, Araif-el-Naga (M 3426/7).
- Figure 5. *Anodontophora münsteri* (Wissmann). x1. Lower Ladinian, Ramon (HU 20478/1).
- Figure 6. *Anodontophora münsteri* (Wissmann). x1. Lower Ladinian, Ramon (HU 20478/2).
- Figure 7. Cf. *Anodontophora fassaensis* (Wissmann). x2. Anisian (?), Araif-el-Naga (M 3428).
- Figure 8. *Pleuromya* cf. *mactroides* (Schlotheim). x1. Lower Ladinian, Ramon (HU 20480).
- Figure 9. *Pleuromya* cf. *mactroides* (Schlotheim). x1. Lower Ladinian, Ramon (M 3416).
- Figure 10. *Pseudoplacunopsis fissistriata* (Winkler) attached to a nautilid shell. x0.5. Lower Ladinian, Ramon (HU 20484).
- Figure 11. *Pseudoplacunopsis fissistriata* (Winkler) attached to a ceratite shell. x0.5. Lower Ladinian, Ramon (HU 20483).

יוצא לאור ע"י

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